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Stadia Physiologica Duo;
OR,
TWO STAGES
IN
PHYSIOLOGY:

Exhibiting all along
The Opinions of the best Writers,
BOTH IN
ANATOMY, and ANIMAL OECONOMY,
Disposed in a regular and natural Order, and
accompanied with a Variety of Observations en-
tirely new.

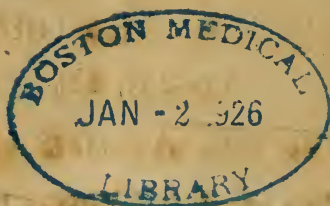
By JOHN FREE, D. D.
Sir John Leman's Lecturer, at St. Mary-Hill, LONDON;
And Lecturer of Newington-Butts.

Εγὼ δὲ τί βέλομαι; καταμαθεῖν τὴν φύσιν καὶ ταύτην ἑπισταί. ζῆτω
ἔν, τίς ἐστὶν ὁ ἐξηγούμενος; Epicteti Enchiridion. Cap. 73.

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Eâ, quâ par est, Humilitate,

D. D. D.

JOHANNES FREE,

Sacræ Theologiæ Doctor,

ET

(Evangelistæ ad Exemplum,)

MEDICINÆ STUDIOSUS.

March 25,
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P R E F A C E.

*AS the World may be somewhat curious to know the Reasons why the Author, who has published so many Theological Pieces, should chuse to employ himself in a Work of this Sort, they may be so far acquainted with them, as to understand, if they please, that having entertained from his Youth no small liking to the Study of Physick, to which, besides his natural Inclination, he was afterwards invited by the Opportunities of attending the Lectures of * an excellent Anatomist and Physiologist, then residing in the University of Oxford, he has since imagined, that he could not any where find a more rational and useful Amusement, than by giving Part of his Time to Researches of this Nature ; not esteeming himself, for the future, so much obliged to devote all to the Study of Divinity, in which, after many Years Labour, he has met with such unsuitable Returns, an Event which could never have happened but in Times irregular and tu-*

* Dr. Alcock,

multuous,

P R E F A C E.

multuous, when missing his Reward in his proper Profession, every Man is obliged to do what he can for himself. And this being the Case, why should not a Philosopher, who will use it as well, enjoy as much Liberty as the Rest?

Omnis Aristippum decuit Color, & Status & Res
Tentantem majora fere præsentiis æquum. HOR.

Thus much for the Times, and the Reasons, they have afforded for the Author's withdrawing a great Share of his Attention from a Profession, wherein his best Endeavours, and the best Part of his Life have been so miserably thrown away.

His Design in this Undertaking was principally for the Help of his own Memory, to make a Collection from some of our best Physical Writers: But in the Course of his Reading, as he found them often at Variance, it was necessary in this Case to relate the Circumstances wherein they differed; to reconcile them, if he could, or at least to establish some of their Opinions, that the Subject might not be totally dark; which Attempt has unavoidably introduced a few Remarks and Reasonings of his own;—he had it moreover in view, to distribute the several Parts of the Art of Physick in a Manner more convenient and comprehensible than usual; and to unite, as much as possible, the ancient Method of treating these Subjects, with later Discoveries, and the Nature and Reason of Things, the Observation of which makes all that is valuable in the artificial or arbitrary Forms of Instruction.

For

For beside his own Amusement herein, he saw further, that, if such a Plan as this were well executed, it might be of Service to a Multitude of Practitioners, whose Knowledge goes no farther than the meer compounding of Medicines, having never been so fortunate as to receive an Education, that might give them the least Insight into Philosophical Principles or Theory. Nor would it's Utility rest with these People: For in the Absence of the compleat Physician, Books of this Kind may be of great Service to Country-Gentlemen and Country-Clergy: in which latter Capacity the Author often found himself obliged to act the Part of a Physician, or to see his Parishioners perish for want of timely Assistance.

Lambeth, March 25,
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The

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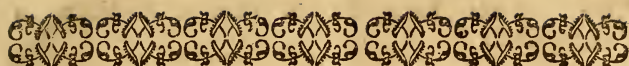
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I. HISTORY of the *English* Tongue, with the Author's intended Dedication to his Royal Highness Prince George; now K. GEORGE III. PART I. printed in 1749, and containing an Account, I. Of the *Roman* or *Latin* Tongue, as once spoken in *Britain*. II. Of the *British* or *Welsh*, and its antient, and present *Limits*. III. Of the *Pyhtas*, corruptly called *Picts* by the *Romans*; their Settlement in the *North* of *Britain*; the Original of their Name, and the Nature, Extent, and Duration of their Language. IV. Of the *Scots* from *Ireland*; and the Extent of the *Eerse* Language; in order to distinguish it from the *English* in the *North* of *Britain*, which vulgarly passes under the Name of *Broad Scotch*.

N. B. This Book was written by Permission of his late Royal Highness FREDERICK Prince of *Wales*, for the Information of his eldest Son now King GEORGE III.

THEOLOGICAL.

I. A SERMON on the Being and Providence of God, preached before the University of *Oxford*, July 8, 1739.

2. A SERMON at the same Place Nov. 5. 1745, when the Rebels were advancing to *Derby*.

3. A Volume of SERMONS preached before the University of *Oxford*, printed in 1750. With a *Preface* tending to expose some remarkably bad Practices, both in *Church* and *State*. THEOLOGY POLEMICAL; or,

A Controversy with the People called *Methodists*, written occasionally against divers of the Sect, in the Years 1758 and 1759, and consisting of the following Pieces:

1. A Display of the bad Principles of the *Methodists*, in certain Articles proposed to the Consideration of the Company of *Salters* in *London*, 2d Edition.

2. Rules for the Discovery of false Prophets, &c. a Sermon preached before the University of *Oxford* on *Whitsunday*, 1758, dedicated to his Grace the Archbishop of *Canterbury*, the 3d Edition.

3. Dr. Free's Edition of Mr. *Wesley's* first *Penny Letters*, the 2d Impression, dedicated to Mr. *Wesley*.

4. His Edition of Mr. *Wesley's* second Letter, &c.

5. His Remarks upon Mr. *Jones's* Letters, dedicated to Dr. *Hoadley*, late Bishop of *Winchester*.

6. Dr. Free's whole Speech to the *London* Clergy at *Sion* College, May 8, 1759, with a Remonstrance to the Bishop

BOOKS formerly written by the Rev. Dr. FREE, &c.

Bishop of *Winchester*: That printed in the *Monitor* is imperfect.

1. A Speech at the *Town-hall*, in *Oxford*, before the Mayor and Aldermen, upon taking up his Freedom of the City, July 30, 1753, containing a concise Account of the *English* Constitution both *old* and *new*; and of the Rise and Progress of the *modern* Part of that Assembly, called the P.

2. Seasonable Reflections upon the Importance of the Name of *England*, &c. in a Letter to a Member of Parliament, 1755. POLITICAL PIECES.

3. Political SERMONS and DISCOURSES, collected into one Volume, under the Title of *Sentiments* of a true *Antigallican*; and dedicated to his R. H. the Duke, 1756.

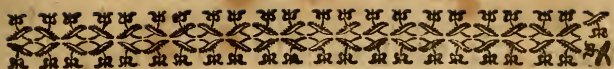
4. An *Antigallican* SERMON preached at *Aldgate* before Admiral *Vernon*, 27 April, 1753.

5. A second *Antigallican* SERMON preached in the Year 1756, upon the Terms of *national* Unanimity: With a *genealogical* Table, shewing his Majesty's antient Connections with the Crowns of these Kingdoms, long antecedent in Time, to the Marriage of his Ancestor with the *Steward* Family. POETICAL WORKS.

POEMS upon several Occasions, the second Edition, 1757, containing an ODE to the King of *Prussia* on the Victory at *Prague*; an ODE of *Consolation* to his R. H. the Duke of *Cumberland* on the Loss of *Minorca*, &c. *Jephtha*, an Oratorio, set to Musick by Mr. *Stanley*; Advice to the Fair Sex; *Stigand*, or the *Antigallican*, a Poem; *Susanna*, an *Ethick* Poem; *Judith*, an *Heroick* Poem, &c.

To the whole is prefixed a curious Account of the *Origin* and peculiar *Nature* of *English* Poetry, and how far it is similar or different from that of the *Greeks* and *Romans*, in a Letter to a Member of Parliament.

N. B. What Books remain of the above Catalogue, are sold only by the Author, at his House in *Lambeth*, near *Westminster-bridge* Turnpike. Where likewise his *Physiology* may be had.—These and some political Pieces in the Name of an *Antigallican*, and likewise a Plan in the *Monitor* (I think it is No. 58.) for *invading* the Coast of *France*, and perhaps a single Sermon or so, are, as near as I can recollect, all that I have printed. For, notwithstanding the Disingenuity of some People, in endeavouring to make me the Author of an History of the Bible, I never wrote or printed any Thing of that Sort; and was an entire Stranger to all the Artifices, great or little, ^{used} upon that Occasion. Apr 26 1762 J. FREE.



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TWO STAGES
IN
PHYSIOLOGY, &c.



PRÆCOGNITA, &c.

CHAP. I.

*Concerning the Constitution of Medicine; or
what is understood by the Art of Physick.*

 F the three *Seëts*, which have been remarkable in this Art, to wit, the *Methodick*, the *Empirick*, and the *Rational*, I shall chiefly take Notice of the last: whose Precepts (as they were a Family, that far excelled the rest) I shall deliver briefly, and with all the Perspicuity that I can. And with this View

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it

it is, that I begin my Work, with explaining the Nature and Constitution of the *Art of Medicine*. For if the Nature of the Thing itself be not rightly comprehended, all the other Parts of Knowledge, which are to serve as its Dependencies, will be of Course mistaken.

Three Things then may be said to constitute, what we call in *English*, the *Art of Physick*, namely, its *Subject* (to which the Principles of Medicine are referred) its *Division*, as accommodating itself to the Varieties of that *Subject*; and lastly, its *End*: And in these three Articles the whole consists.

The *Subject* then of the Physician's Art is certainly the human Body, as far as that is liable to Diseases, and those Diseases are supposed to admit of Cure.

For though *Man* may be, in different Respects, the Subject of Consideration, to the moral Philosopher, the natural Philosopher, and the Divine; yet none of these consider him in the Manner that the Physician does, in Relation to his Health: And therefore it is this particular Manner of considering the Subject, which distinguishes the Profession of the latter from the rest. For natural Philosophy only regards Man as a moveable Body; Ethicks, or moral Philosophy, as a Creature discerning Good and Evil, and therefore capable of moral Obligation. It is no Objection to this Reasoning, that natural Philosophy hath some things

things in common with the Art of Medicine; as for Instance, the Doctrine of Physiology, because in this Part, Medicine intrenches upon natural Philosophy, and takes the Conclusions of those Philosophers, for its own Principles. For which Cause, this Part of Physick is sometimes called Speculative; not that it is totally speculative, but only somewhat farther removed from Practice than the Rest.

And although Plants, Roots, and Minerals, and other such things as usually constitute, what they call the *Materia Medica*, or Matter for Physick, should be here considered, yet it is all with regard to their Effects upon an human Body. For the Uses of which, their several Temperaments and natural Virtues fall under the Observation of Physicians.

Thus much then may suffice to inform the Reader, that the Subject of Physick is the human Body, as far as that is liable to Diseases, and those Diseases are supposed to admit of Cure.

With Regard to the *End*, we are to observe; that, whereas in Arts, which are merely speculative, their *End* is nothing different or distinct from the Knowledge of those Things, which are the Subject of such Arts; (which is evident in the Study of pure Mathematics) yet the Nature of every practical Profession is quite otherwise; for there the *Knowledge* acquired does not rest in itself, but has a Tendency to something else, as in the Application

of Geometry to Mechanicks. In like Manner the Art of Physick, as it is something practical, applies all the Knowledge it gathers from Philosophical Speculations to another Purpose, which we call its End; and this End is Health; or the acquiring and maintaining of that Soundness of Constitution to an human Creature, whereby all the Operations belonging to his Frame, whether animal, vital, or natural, shall be performed in a regular Manner, without Interruption or Disorder. This, I say, is the End of the *Art* of Medicine, its Precepts having Relation either to the Preservation of present Health, or the Recalling that which is absent. It is incumbent upon a Physician therefore, not only to remove a present Disease by the proper Remedies; but also diligently to provide against the Return of it; and to prescribe such a Form of Diet, and Rule of Life, as may prolong and preserve that Health, which he may have had the good Fortune to restore. For to cure is not only to remove the Causes of Hurt, but also to guard against them, when at a Distance. For this Reason the Art is described by *Hippocrates* (in his Book *de Flat.* if that Piece be his) to consist of Ejection and Detraction. Which Things can never be effected without an accurate Knowledge not only of the human Body, but also of all Sorts of Medicines, as well simple as compound.

Thus much of the End; and now for the *Division*, or several Branches of the Profession.

Though

Though *Galen*, having Respect unto its End, hath divided Medicine into two Parts, (*ὕγιεινῃ*) the *preservative*, which preserves health, and keeps *from* impending danger; and (*θεραπευτικῇ*) the *sanative*, which restores it when it is lost: Which two Parts, by Reason that they belong to Practice, are by some termed the practical; yet others, not improperly, make another Division of it, into Physiology, Pathology, and that which is called Semeiotick, and relates to Tokens or Signals.

By Physiology here, is not understood the Consideration of every natural Body, but only of the human, and such Things as according to the Course of Nature are to be met with in the same. Pathology explains those Things which happen contrary or disagreeable to the Nature of Man; such, for Instance, are Diseases; the Cause of these Diseases, and the Symptoms of the same. The Semeiotick from Tokens, not only judges of the present or past Constitution, but also foresees the Event of a Disease. By some Writers, however, these three Divisions are referred to the speculative Part of Physick, the practical again contains as many; the diætetic, the pharmaceutick; and chirurgick. The first, by considering the six Things, which are called Non-naturals, prescribes to every Man his proper Course of Life. The second undertakes to drive out the Disease by proper Remedies; and therefore to

this Part belong the Knowledge, and Preparation of Medicines.

The last delivers *Rules* for manual Operations, such as burning, cutting, replacing, &c. and is now, by the Corruption of the *Greek* word, commonly called Surgery in our Tongue.

From all which Divisions or Branches of its Office, it appears that Medicine, or, as we call it, Physick is, in all its Shapes and Forms, *an Art productive of human Health*; I say an *Art*, for strictly speaking it is not a *Science*. And therefore *Avicenna*, in the Beginning of his Work, though he has given it that Title, yet to determine his Meaning more particularly, immediately after calls it practical. I mention human Health in the Definition of the Art, to distinguish the Physician from the Cow-leech or the Horse-doctor; and I add the Word productive or effective, because to produce is not only to call back by Medicine the Health that was lost; but also for this Reason, because to preserve Health when present, by the Means of wholesome Aliments, may be likewise called Production.

C H A P. II.

*Of the Manner wherein the Ancients treated of
Physiology, and an Attempt to reconcile their
Method with one more agreeable to later Dis-
coveries, and the Reason of Things.*

THOUGH Physicians, after *Galen*, have established a *threefold* Manner of treating Subjects relating to their Art; that is to say, either by *defining*, *compounding*, or *resolving* them: yet, because the Use of *Definition* is by no Means the sole Property of Physick, I shall confine myself rather to speak of the two Methods last mentioned, known in the *Greek* by the Names of *synthesis* and *analysis*, that is, the Illustration of a Thesis, by compounding the Precepts, or resolving them.

Order or *Method* in general may be defined a proper Discovery of the Relation, which many Things bear to one. The *analytick* Order, or which is the same, the Method by Resolution or Solution, is that, which in treating of any Art, teaches the Student to refer all Things to one End: therefore as it is the *principal* Thing in View, in the first Place it treats of this End, and then investigates the Means, by which you are to attain it. This Method is observable in *Aristotle's* Treatise of *Ethicks*, and his Book of *Demonstration*. And it is in this Order, that all Precepts of Art, whether practical or theoretical,

are generally delivered. But the compound-
ing or *synthetick* Method, on the contrary,
beginning with the first and most simple
Causes and Principles of Things, proceeds
to a System, which rises gradually to a whole
or Superstructure upon those Principles, and
without which it cannot subsist. It is in this
Manner, that the aforementioned Philosopher
composed his *Acroamatics*, and following
Books, and it is in this *synthetick* Method that
Physicians have chosen to treat of *Physiology* ;
herein observing what has been antiently prac-
tised by the *Arabick* Writers *Avicenna* and
Averroes. And because the human Body, which
is the Subject of *Physick*, has its Principles and
internal Causes, namely, its Elements, in a
Treatise of this Sort it was the Custom to be-
gin with these.

This Part of the Art of *Medicine* is called
Physiology. The Matter of its Consideration
being *human* Nature, and such Things, as in
the Course of Nature generally attend it ;
which Articles were formerly reckoned seven
in Number, and usually distinguished by the
Name of the *NATURALS*: To wit, *Elements*,
Temperaments, *Humours*, *Spirits*, *Parts*, *Facul-
ties*, *Functions*, or *Uses*.

These *Res naturales*, or *natural Things*, in
Order, as they are here arranged, generally
made the FORM of an old *Treatise* of *Physi-
ology*: But this Method, though not entirely
to be rejected, has its *Defects* and *Inconve-
niences*.

For

For though the Doctrine of *Elements* and *Temperaments* stand well enough in their Place as *Præcognita*; yet they have Respect to different Branches of the Science, which Thing is not mentioned; the Doctrine of *Elements* belonging to PHYSIOLOGY in general; and that of *Temperaments* only to the particular PHYSIOLOGY of an *human* Body, which again divides the Subject, though taken largely, but into *two* Parts; whereas there should be *three*. For as the Properties of other Bodies are only investigated by the Physician for the Sake of applying them to the *human* Service, here is this Branch of Application omitted in the general Division. Whereas to be adequate to it's Subject, PHYSIOLOGY, considered in it's full Extent, should be divided *first* into *common*, and *proper*, and then into that which is *comparative* or *mixed*. PHYSIOLOGY *Common* treats in general of all Kinds of *material* Substances; *animal*, *vegetable*, and *natural*, &c. PHYSIOLOGY *Comparative* or *Mixed*, treats of the Application of such Substances to the Uses of the *human* Body: But PHYSIOLOGY *Proper* treats of the *Structure* and *Oeconomy* of that Body alone.

Upon this Enlargement of the Plan by a *general* Division, the Use of the Chapters concerning *Elements* and *Mixtures* more plainly appears; as likewise that of *Temperaments*: Since they all serve as *Præcognita*, or *Preliminaries* to the different Parts of the Science,
the

the first to *PHYSIOLOGY Common*, the second to that which may be called *Comparative* or mixed, the last to *PHYSIOLOGY Proper* or *human PHYSIOLOGY*.

Thus much of the *Deficiencies* in the old System; in the next Place let us observe it's *Inconveniences*.

The several Articles of the *PARTS*, their *FUNCTIONS*, and their *USES* are injudiciously divided from each other, and the latter thrown at a Distance from the Parts themselves into different Chapters; whereas they cannot well be treated of afunder. For if the Parts be described at large that Description will comprehend their *Functions* and their *Uses*: but if on the contrary they are described so imperfectly, as that their *Functions* and *Uses* shall be severed and reserved for distinct Chapters; why then those Chapters must have a continual Retrospect to what went before; and consequently be filled with Repetitions and Citations from the Chapter of the *Parts*, which is a Method absurd and inconvenient.

With Regard to the *HUMOURS* also, it may be observed, that as they are the immediate Effects of the *FUNCTIONS*, or Operations of their respective Parts, they can in no Place be so properly described as in Conjunction with these Parts, which contain, or produce them.

As

As to the Subject of SPIRIT or SPIRITS, which the Ancients divided into *vital* and *animal*, and of which they made a distinct Chapter, they in a Modern Treatise, will either be spoken of with the Blood, or else come more properly under the Head of *Secretion*, and so that Article, as a Branch of a general Division, may be suppressed.

The Word *Faculties* tho' may still be made Use of, as it serves, when accurately explained, to reduce the several Operations in the human Frame more precisely to their proper Classes. In general, all the *Powers* and *Functions* of the Body may be called *Faculties*: But as in their Use and Tendency, they are very different, they require some Marks of Distinction. To this End the several Degrees of *Faculties*, as *natural*, *vital*, *animal* were invented, to correspond with the several Degrees of Soul *vegetative*, *animal*, and *rational* (to which last Purpose however none of them were suited) and to distinguish the several Operations of these Souls as they existed apart in different Sorts of Beings.

But when those several Operations came to center in one Being, the Use of so many Divisions of the Word *Faculty* only bred Confusion. For Instance, the *Faculty* called *natural*, not being distinguishable in an human Creature from the *vital*, as it is when it appears by itself in *Plants*, *Trees*, and *Zoophytes*, was *lost* and comprehended in the *vital*,
and

and so there remained, in this Respect, a Distinction without a Difference. For as to the Definition of the former, it comprehended the Operations of the latter. The *δυναμις φυσική*, or *φυσική* of *Galen* was distinguished by this Description—"Tota inservit individui Conservationi, et Speciei Propagationi: Ejus enim Functio est Accretio, Nutritio, Generatio."—And what can the vital Faculty in Man do more? The *natural* FACULTY therefore and the *vital* are Things of the same Kind in an human Creature. For which Reason one of these Terms alone should be retained, and as the Things themselves are best expressed by *vital*, that should be the Word. Again, as the Term *animal* approaches in some Respects near in Sense to *vital*, while in others it is far remote, to avoid *Ambiguity*, I would have that also, unless it be applied to the whole Creature, laid aside, and its Place in the Division of Faculties supplied by the Word *sensible*, or *sensitive*; as *sensible Faculties* are easily distinguishable from *vital* Faculties on one Hand, and *rational* on the other, which three are all the Faculties, that exist in an human Creature, and which by these Words are expressed *distinctly*; whereas the Word *Animal* is a collective Term, which when applied to the Faculties of Life and Sense existing in one Creature, may comprehend them both; and therefore,

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can be no Mark whereby to separate each from each, or fix the exact Idea of either.

The Word *Faculty* then thus limited and explained, may yet be a Term of great Use, and assist us to distinguish the *sensitive* Part of PHYSIOLOGY from the *vital*: The Functions *supported* from the Functions *supporting*. For *Chylification*, *Sanguification*, *Inspiration*, *Secretion*, *Nutrition*, &c. are Functions *supporting*: But the *Senses*, as well *internal* as *external*, are Functions *supported*, and depend upon the Continuance of the other. This Distinction exists in Nature, and the Want of observing it, has occasioned great Irregularity and Confusion in the Treatises of good Operators among the Moderns: But Skill in Writing, and the Business of Experiment, are Talents seldom united in the same Person, and therefore SCIENCE perhaps might be made more useful to the World, if one Set of Men were employed to make Discoveries, and others to digest their Discoveries, and explain their Meaning. And with Regard to what has been argued upon this Subject, the following may serve as a SYNOPSIS of *Physiology* in all it's Parts:

PHYSI-

PHYSIOLOGY is either

I. General or Common.	II. Proper or Human.	{ Out of which two a- rises,	III. Comparative or Mixed.
It's <i>Præcognita</i> , The Doctrine of Elements and <i>natural</i> Mix- tures.	It's <i>Præcognita</i> , Elements & Tem- peraments.		It's <i>Præcog.</i> , Elements, and <i>natural</i> and <i>ar-</i> <i>tificial</i> Mix- tures.
<div style="display: flex; justify-content: space-around; align-items: center;"> ⎵ Its general Branches, ⎵ </div>			
FACULTIES		FACULTIES,	
Preserving or continuing Life.		Or Modes of Sense.	

To the first *Branch* of Faculties preserving or continuing Life, belong the following *Particulars*.

1. Functions of the Parts which serve to (prepare and convey the Chyle, which may be called) CHYLIFICATION.

2. Functions of the Parts containing and conveying the Blood, which Article comprehends the Action of the Heart, the Lungs, the Arteries, and Veins, and for the Sake of being expressed by one Word, may be called SANGUIFICATION.

3. The Functions of the Parts serving to SECRETION.

4. OF ACCRETION OR NUTRITION.

5. EXCRETION.

6. GENERATION.

7. SLEEP:

All these proceed by Stages and Gradations, and seem to be connected in their Operations.

To

To the second *Branch* of Faculties, or Modes of Sense, belong the following Particulars:

1. WATCHFULNESS.

2. INTERNAL SENSATION, as Hunger, Thirst, Desire, Fear, &c.

3. EXTERNAL SENSATION. The common Modes of which are,

1. TOUCHING.

2. TASTING.

3. SMELLING.

4. SEEING.

5. HEARING.

Modes of *mixed Sensation* being sometimes internal, sometimes external, and sometimes partaking of both, are,

PLEASURE and

PAIN.

Faculties *depending* upon *Sense*, and sometimes attended with it, are,

1. MUSCULAR MOTION in *general*.

2. In *Specie*, as
SPEECH,

MANDUCATION DEGLUTITION. These last are also Faculties tending to preserve Life, and in that Capacity come under the Head of *Chylification*, as far as they are Instruments to that Faculty.

All these Faculties are but the Effects of one Cause: Whereas the Antients considered the Faculties as so many Causes, and as such assigned them an imaginary Residence, some in one
Part,

Part, some in another; the *natural* Faculty was to take Possession of the *Liver*, the *vital* of the *Heart*, and the *animal* of the *Brain*. Hence the Division of Medicines into *hepatic*, *cardiac*, and *cephalick*. But now true Philosophy has despoiled these Faculties of their State, and will allow them to be no more, than has been represented, *mechanick* Movements, and Effects depending upon a *mechanick* Cause.

Taken all together, they make that Kind of Being, which PHILOSOPHERS call the *Soul of Sense*; PHYSICIANS the *Anima Medica*; but MOSES more properly (נפש חיה, or) *the Soul of LIFE*, which is nothing more than *the Machinery of the Body kept at work by Ventilation*. For as soon as a Man is born, it is put into Motion by what the same Historian calls *the Breath of Life*, or the *Action* of the *Air* upon the *Lungs*, in the same Manner as a Wind-mill by it's Sails, and this Motion is continued by the Re-action of an antagonist Muscle the Heart.

How the Business of Life is carried on before a Man is born, and the Lungs have acquired their Motion is not so clearly discovered, especially in the first Stages of Being; but after the Communication by the *Funiculus* is formed between the Parent and the Child, is it not possible that the Impetus or Action of the Lungs and Heart of the Mother upon her Blood, may cause in some Measure

sure the Circulation of the Blood in the Child? If the old Notion of *Galen* and his Followers could be supported, it would not be incredible, that with the *Blood* of the Mother the *Circulation* should be conveyed likewise.

But of these Matters in their proper Place: I am at present to speak first of Physiology in *general*. I cannot however close this Chapter without observing, that by reckoning the foregoing Operations to be Faculties, we at once increase the *Naturals* and intrench upon the old Scheme of the *Non-naturals*, which were generally accounted seven in Number; to wit, 1. *Air*. 2. *Meat* and *Drink*. 3. *Retentâ* and *Excreta*. 4. *Sleeping* and *Waking*. 5. *Motion* and *Rest*. 6. The *Perturbations* or *Passions* of Mind. As five of these Articles are necessary to the Being of a Man, and the last unavoidable, one would wonder that they could not find a fitter Name for them than *Non-naturals*. But Custom has made it familiar, and the talking Part of our Practitioners would be concerned to lose a Term of Art, which has more than once made their Patients admire their Learning.

C H A P. III.

Antient Notions of Elements and Mixtures compared with the Opinions of the Moderns.

ALTHOUGH the Knowledge of Elements is, in the Language of Physicians, usually confined to the Science of human Nature; yet it may very well be extended to the Knowledge of other Bodies, which have their Use and Application in the Art of Physick; which will appear very evident, when the Force of Medicines, and their several Qualities, come to be considered more particularly. Not that we shall ascend, with the natural Philosophers to the most curious Contemplation of first Principles, but taking our Stand rather within the Limits of our proper Province, pay no farther Attention to the Doctrine of Elements, than to consider their Force as they relate to Mixtures.

An Element then, according to the old Physicians, is a simple Body, from which Sort of Bodies all Mixtures at first arise, and into which they are ultimately resolved.

They say a Body, as not regarding here those first, and as some will have it, ideal Principles of Matter and Form: For though in our Ideas it may be compounded of these, yet they call it simple, as contradistinguished from Mixture, as if one were to say, that pure Element, as Air, is not compounded of other

other Elements, as a Bone, or a Piece of Rhubarb are : And although the heavenly Matter be really a simple Nature, yet, as it has no Relation to the Composition of other Bodies; (for our Mixtures are not made of the heavenly *Æther*,) therefore for Precaution's Sake they add the other Words to the Definition, and make the medical Elements to be those, into which other Mixtures may be ultimately resolved.

That these Elements are four in Number, natural Philosophers demonstrate; partly from their moving Qualities, and partly from their Alterative, such as their Heat, their Coldness, their Moisture, or their Dryness. And although the Action of the Elements in Mixtures arises from these prime Qualities, yet there was a Dispute whether these Qualities were substantial Forms, or rather the Instruments of the Forms themselves. It was agreed however, whatever they were, that these Qualities would be most intense and most perfect, in the Elements themselves. It being a Maxim in Philosophy, that whatever makes any Thing of such or such a Quality, must itself have more of that Quality, in Order to impart it. Mixtures take their local Motion from the predominant Element; and in the same Manner they heat or cool. And though Philosophers may consider the Elements, not only as the Principles of all Mixtures, but also as integral Parts of the World, inasmuch as they are all destined

to occupy their several Places: Yet Physicians seldom regard them in this latter View, but principally in the former; and omitting their loco-motive Qualities, attend to them in their alterative. They suppose therefore from natural Philosophy, that Fire is the hottest Element and the dryest; that Earth is very dry and very cold, (the passive Qualities in all are most intense, the active not so) Water is very moist and cold; Air is warm and very moist. Heat is of the greatest Activity and least Resistance, they mean the Resistance which the Philosophers call privative, and not positive, which latter is always equal to the Activity. DRYNESS, on the other hand, is of the least Activity, and the greatest Resistance. To the Activity of Heat, Cold approaches the nearest; but its Resistance is greater. MOISTURE is more potent in Action than Dryness, but not in Resistance.

These are, according to the old Account, the Proportions subsisting between the Elements. For if Fire, they said, had resisted in the same Proportion that it acts, it had long since consumed or swallowed up the rest. But since it is so ordered by Nature, that every one of these should act upon its contrary, from this mutual Action arises the Temperature of all Mixtures, as well in Nature, as the Works of Art; as may be seen in the Preparations of the Shops. And because
the

the Elements are thus formed and disposed for Mixture, their Qualities are distinguished into active and passive. Heat and Cold have the Nature of an agent; Moisture and Dryness of a patient; because by their Means the subject Matter is disposed to receive the Form of a Mixture; in other Respects they are Agents, tho', as I observed before, in an inferior Degree. In fine, it is so ordered in every Mixture, that it's Bulk and Corpulency should be taken from Earth and Water: But it's Force and Power of Action from the other Elements. If one Element is too predominant in Action, there will be no Mixture, but rather the Generation of a simple Element: If they engage with equal or not very unequal Forces, a Mixture will ensue. For the Mixture is neither Water nor Fire, but a third or distinct Thing, containing in itself the Nature of the Elements compounded, but in an inferior Degree. All Mixture is the Generation of a Thing mixed, which that it may happen, there must be a Concourse of the Elements into one Place; a Division of the same into their least Particles; and lastly, a Reaction, wherein by the mutual Attrition of each other all Things are corrupted or altered from what they were, and something is generated quite anew.

The Moderns agree pretty well with the Antients in what relates to the Doctrine of Mixtures in general, tho' with Regard to

Elements, their Terms and Notions are somewhat different.

They say, with the Antients, that with Respect to Mixtures, it is impossible to discover the Virtues of any Body, or how mixed Bodies of any Kind stand related to the human Body either for the Preservation of it's Functions entire, the restoring them when lost or impaired, or for the total Destruction thereof, till we know the Principles of which they consist, Wherefore having discovered by various ways, the Parts, into which all Bodies are resolved by a true CHYMICAL *Analysis*, they look upon such simple Parts, to be solely *Elements* or Principles of which the more antient of these Investigators reckoned five, that is to say, a *Spirit* or *Mercury*, *Sulphur*, *Salt*, *Water*, and *Earth*.

If Wine; for Instance, were distilled in a proper Alembick, a burning Water, or Spirit would first arise, next an insipid Water, which they call *Phlegm*; a thick viscid Mass alone remaining in the Still. This they put into another Vessel, or Retort which being exposed to a more intense Heat, a small Portion of *Phlegm* comes over first, then an acid Water, which according to them is stiled *Spirit* or *Mercury*; next a fat oily Substance called *Sulphur*, what remains still in the Retort is burnt to Ashes in an open Fire. These Ashes are thrown into an Earthen Vessel with a proper

proper Quantity of boiling Water, which they impregnate with Salt, this Water being filtrated through Cap-paper, and afterwards evaporated leaves the *Salt* at the Bottom. The other Part of the Ashes, which the Water does not take up is termed Earth, or *Caput mortuum*.

Of these five Substances, the *Chymists* have reckoned two to be *passive* WATER, and EARTH; and three *active*, SPIRIT, SULPHUR, and SALT; on these last they thought the whole Virtue and Efficacy of mixed Bodies depended.

In this *Analysis* we may observe, that there is a twofold SPIRIT; one oily and inflammable, which rises by a gentle heat and is termed Spirit of *Wine*; another acid and penetrating like that of Vinegar. Beside these the Chymists give the Name of Spirit to other penetrating Liquors, obtained from the Parts of Animals; such as the *Spirit of Urine*, *Harts-Horn*, *Blood*, and such like Substances. But the later Chymists have banished these Spirits from the Number of their Principles as being nothing else but Sulphur or Salt dissolved in Water. Thus Spirit of Nitre, and others of that kind, are only acid Salts in Water; Spirit of Hart's-Horn, or Urine, alkaline Salts; and Spirit of Wine, or Turpentine, an æthereal attenuated Oil.

Some of the Moderns deny likewise, that either *Sulphur*, or *Salt* deserve the Name of Principles

Principles, or Elements, as not being the most simple Substances produced by Chymistry. For *Sulphur* when treated with due Care may be resolved into *Salt*, *Water*, and *Earth*; as is evident by distilling fætid distilled Oils several Times with quick Lime; which by this Treatment yield in large Quantities, a volatile *Salt* dissolved in Phlegm, together with a *Caput Mortuum* or Earth. Likewise ætherial Oils are only fat thick Oils, like those of Olives, attenuated by Salts and dissolved in Water, as may be proved by these two Experiments: If Oil of Olives or any others of that Kind, be mixed with a fermenting Liquor such as a Solution of Honey in Water, the whole will be converted into an inflammable Spirit. And if a Quart of Spirit of Wine, diluted with six Quarts of common Water be exposed in a cold Place to the open Air the volatile Salts will fly off, and leave Drops of Oil swimming at the Top, which are in all Respect the same, as Oil of Olives or Almonds, *Salt* has no better Title to a Principle than *Sulphur*, because it may by proper Management be at length reduced to *Earth* and *Water*. Thus *Nitre* by Distillation may be almost wholly reduced to an acid Spirit, but if it be burnt with Tartar, or charcoal Dust it becomes an Alkaline Salt called fixed Nitre. This if suffered to run *per Deliquium*, and being afterwards filtrated through Cap-paper will leave a large Quantity of Earth behind, and if the same Liquor be distilled to Dryness,

a large

a large Quantity of insipid Water will come over, and the Salt remaining at the Bottom of the Retort, will have lost a great Part of it's first Quantity. If this Operation be repeated, nothing will at length remain but *Earth*. Again the Vitrification of Alkaline Salts seems to be nothing but the Conversion of the same into Earth more compact and less porous. For *Glass* in other Respects, has no Qualities different from those of *Earth*.

What we have proved by Experiments made by resolving Bodies, may be farther confirmed by others relating to their Formation or Composition, and particularly by *Van Helmont's* famous Experiment on the Willow, which has been often quoted by succeeding Authors. He took about two hundred Pounds of Earth dried in an Oven, and put it into a Vessel covered with an Iron Lid full of Holes. In this Earth he set a Branch of Willow weighing about five Pounds, which soon took Root, and grew so much that in eight Years it weighed one hundred and sixty Pounds, the Earth, it stood in, during this Time, having lost only a few Ounces, so that the whole Increase of the Tree must have been owing to Rain-water, and a very small Proportion of Earth (this Author seems to have forgot Air, as a Principle of Vegetation but of this by and by) and therefore says he, (still in the Style of a Chymist) the Salts and Sulphur therein must have been composed of these Elements alone.

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The Experiments of this Kind made by the illustrious Mr. *Boyle*, on small Sprigs of Mint, Marjoram, Pennyroyal, Baum, &c. are more to be depended on, being set in clear Water, they increased in a short Time to double their first Weight, and being afterwards distilled, they yielded the very same Principles, which they would have done had they grown in the most proper Soil; from whence it is plain that Salt and Oil owe their Original to Water and Earth.

Water, and *Earth* do in the strictest Sense deserve the Name of Principles; but in the Formation of mixed Bodies, a third Principle (and why not a fourth) must necessarily concur with them. For as they are of themselves wholly inactive, something must be supposed to give them their Motion and Activity, without this, Water would immediately turn to Ice, and as there are few Bodies, out of which Fire may not be drawn, it is evident that there must be some active moveable Principle in them all, to which the Motion of the other Parts is owing. Therefore tho' this Principle should not fall under our Senses in the same Manner as the others do, that can be no Reason for doubting of it's Existence, since it must concur in the Composition of all Bodies, which if they were made of Water and Earth alone, would remain for ever without any Virtue or Energy. This they must receive from another Principle; and

and according to the different Combinations of all the three, Bodies are formed with different Properties and Powers. These Writers therefore acknowledge three simple Substances in Bodies, which are properly Elements or Principles. One *Active*, which may be termed FIRE, and two *passive*, WATER and EARTH. From the most simple Union or Connexion of these three, SALT arises, which is therefore looked upon as the most simple of all mixed Bodies. The next to that is SULPHUR or OIL made by the Union of the three Principles aforesaid and of SALT; these *secondary* Elements may be styled *Chymical*; as to the *Primary*, the Reader perhaps will wonder, that in all these different Accounts of the Chymists, they none of them mention *Air* as one. Is it because they cannot see it at the Bottom of a Crucible; or that they acknowledge nothing for a Principle, but what the Fire leaves behind? that cannot be the Reason, for they allow Fire itself to be an Element, however it may be concealed from the Observation of their Senses, which yet is not so much the Case of Air, as they must perceive if they attend to every Stage or Degree of their own Operations, or even the common Effects of Fire in discovering Air, as a Principle.

Let them put *Wine*, as aforesaid, into any Vessel, and heat it, what are the first *Steams*, which arise in the Vessel, but the aerial Particles

ticles of the Fluid, which upon loosening it's Composition by the Approach of Heat, are the readiest to break away the first.

Let them look into a great brass Caldron full of Water any considerable Time before it boils, and they will even see these Particles of Air raised by the Operation of their own Element, Fire ascending by Millions from the Bottom and Sides of the Kettle toward the Surface. Did they never observe in a Coal-Fire, that when the Channels or Flakes of the Mineral come to be opened and loosened by Heat how the Air will break away, and carry on the Flame in a Stream like the Blast of a Blow-pipe? The same may be observed in the Burning of Wood. Nor is it to be imagined that there is any natural Body which is porous, but what contains in it aerial Particles; the same may be affirmed of aqueous, vegetable and animal Substances. But if these *Fire-men* cannot edify by Experiments in their own Way, as being too familiar to be noticed, or else below their Observation: There are Experiments of another Sort to prove the Matter in Question. Let different Liquors, as *Ale*, small *Beer*, and *Water* be put into three different Glasses, and set within the Receiver of an Air-pump, and upon exhausting the same, the Ebullition of the Liquors will shew the Proportion or Quantity of Air contained in each. Put a wrinkled *John-apple* into the same Vessel, and upon

upon exhausting it, as before, the Air contained in the Substance of the Fruit shall expand itself, and visibly fill up every Wrinkle. In a Word without the internal Mixture and Action of the AIR there could be no such thing as animal *Life*, or *Vegetation*. If therefore this Principle be not only distinguishable in itself from the other Elements, but also universally distributed to natural Bodies, to fluid, vegetable, and animal Substances, it answers to *Aristotle's* Definition, which is a very just one; and therefore is truly an Element: For he says, Lib. iii. *De Cælo*. C. 3. Text 31. Ἐσὼ τὸ κοινοῦ τῶν σωμάτων, εἰς ὃ τὰ ἄλλα σώματα διαιρεῖται, ἐνυπάρχων δυνάμει ἢ ἐνέργειᾳ, αὐτὸ δὲ ἐστὶν ἀδιαίρετον εἰς ἕτερα τῶν εἶδει.

Having thus restored the Element of AIR to it's Place, and Dignity, we may reckon with the great Philosopher aforementioned, the *primary* or *real Elements* to be *four*, EARTH, AIR, WATER, and FIRE; and the *Secondary*, or Elements by *Courtesy*, which were invented by the Chymists only *two*, namely; SALT and SULPHUR. For though they generally reckon five of their own, to wit *Spirit*, *Phlegm*, *Sulphur*, *Salt*, *Earth*, as afore mentioned, yet after enumerating these as Principles, *vulgarly* so called, Dr. FRIEND, in his *Chymistry*, makes this just Remark upon them: “ Ita plerumque discriminari, & definiri solent Partes, quas ex Corporibus

Corporibus elicit Ignis *Chymicus*, quæ igitur apud Universos ferè hujusce Disciplinæ Sectatores pro *Principiis* habentur. Hoc quam malè iis conveniat Nomen, non Opus est, ut fusiùs exponam: quæ nec in omnibus Corporibus reperiri, nec in se invicem mutari non posse, ipsi statim videbitis. Et enim hæc omnia, quæ tanquam Elementa vulgo jactantur, sola efficit, Igne admoto; *Texturæ* Discrepantia: ut idem Sanguis per diversa Organa transfusus succos constituit, qui nec Odore, nec Sapore, nec etiam Compagē consentiunt." *Prælectiones Chymicæ*, P.

I I.



C H A P. IV.

A more particular Description of the Elements, and their severall Properties and Operations, as the Principles of Bodies.

ARTICLE I. Of FIRE.

THE Moderns reckon *elementary* FIRE to be the first *Principle* of Bodies, as being that, from whence all the Rest receive their *Activity*. It is of itself a simple, and most subtle Body in a continual swift Motion, filling in Conjunction with the Air, and easily forcing it's way through the Pores
of

of all other Bodies. It's immense Subtilty is evident from this, that it penetrates all Bodies whatsoever: and it's swift Motion, from that Rapidity, which it is capable of communicating to them.

Its Force is in Proportion to the Quantity of it any where collected. In the Sun, which is looked upon as a vast Congeries of this Substance, its Motion is most violent. In culinary Fires the Quantity and Motion of it are not so great, but still greater than in spirituous and volatile Liquors, where it is hardly to be perceived except when they are set on Fire. Not only all *Motion*, but all *Heat* also is owing to it, which as it exists in Bodies, is nothing but the excessive Motion of their Parts. It is too subtle and active ever to be collected pure in *chymical* Analyses: wherever it is found, it is always united with Water and Earth in Salts and Sulphurs; and is sometimes concentrated in Bodies in so great Quantities as considerably to encrease their Weight, as is evident in calcined *Antimony*, where there is an Addition made of almost a fifth Part.

ARTICLE II. Of AIR.

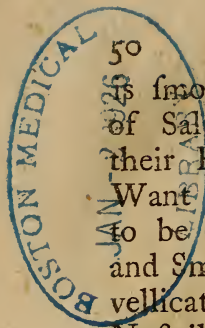
AIR has been reckoned an Element ever since the Time of *Empedocles*, in which Opinion he was followed by *Aristotle* and the *Peripateticks*, who contended, that it entered
into

into the Composition of all Bodies: It even gives Activity to Fire, which could never flame without it. For which Reason, one would the more wonder, that it should of late have been excluded from its Rank among the *Elements*, by some doating *Chymists*; since without it, their Element of Fire itself would have laid dormant, and they could never have made Use of their own Furnaces. It enters into the Pores of all *natural* and *artificial* BODIES, since even *Glass* and *Metals* have their *Pores*: It pervades the Substance of all ANIMALS, and in those of a more perfect Form, it is received in great Quantities, and ministers Support continually by the Pump of the Lungs: In much the same Manner as it is received, tho' in an inferior Degree by VEGETABLES, by Means of their Pipes and *Trachæas*. To give a general Definition, AIR is that pellucid Body, which every where surrounds the Earth, and ministers Life to the whole Creation. It's particular Qualities or Properties are such as these: It is 1. A Liquid, but not like *Water*, a Liquid that can be congealed. 2. It is much lighter than Water, but yet not void of Weight, Water being 840 Times the heavier. 3. From this its Texture, it may be rarified or condensed, whereas the *Condensation* of Water seems impossible to be effected by any *human* Art. 4. Air has a Springiness, or elastick Force. 5. It is pellucid, and so ministers

ministers to the Transmission of Light. 6. It is the great Instrument of *Respiration*, and serves to make the Element of *Fire* useful, by kindling it to a Flame.

ARTICLE III. *Of* WATER.

Elementary *Water* is a simple, liquid, insipid inodorous pellucid Substance, without Smell. Its Fluidity is entirely owing to the Action of Fire, and when that Action is very great, its Parts are actually divided, and the whole turned to Vapour, but when it is very small (I should rather think none at all) they cohere strongly and turn to *Ice*. This Element of Water the *Chymists* call *Phlegm*, and they think it consists of small smooth Particles, of an *oblong* or else *oval* Figure, and perfectly rigid and inflexible. From the Minuteness of it's Particles it easily penetrates the Pores of almost all Bodies. An oval Figure seems more agreeable to the Fluidity and Motion of Water than a spherical, and likewise to the Solidity, we observe in Ice, (perhaps in this Case the oblong Figure is preferable to both,) the Points of Contact being too few in spherical Bodies to form so strong a Cohesion, They observe, on the other Hand, that were it's Particles angular and flexible, they would be too weak to dissolve Salts, and would likewise be too much resisted: but as their Surface



As smooth they can easily enter the Pores of Salts, and afterwards as easily separate their Parts, that is dissolve them. The Want of Taste or Smell in Water, seems to be owing to the Smoothness, Obtuseness, and Smalness of it's Particles, which cannot vellicate the Nerves of the Tongue and Nostrils, the Fluidity of Water arises in Part, from the same Cause, the Figure of it's Particles, and from their easy Motion in the Warm Air, contained in the Spaces between them.

ARTICLE IV. Of EARTH.

Elementary *Earth* is the same with the *Terra damnata*, or *Caput mortuum*, of the Chymists; being a simple, friable, porous Substance, without Smell or Taste, consisting of Particles of no regular Figure, and altogether unfit for Motion. The Porosity of Earth seems to arise from the irregular Figure of it's Particles; and as these Particles oftentimes touch each other only by their Angles, the whole Mass must necessarily be friable. The Want of Taste and Smell may be owing to their Inaptitude for Motion, (in my Opinion this is all Conjecture, as is a great Deal of what this Author advanced, before, in the Article of Water, and the Form of it's Particles). On these Points the *Physician* will

will generally find his best Information amongst the *natural Philosophers*. Upon their Principles I should rather think the Want of Smell in Earth (next to the Simplicity of it's Particles) to be owing to their Gravity, which will not suffer them to be volatilized like the *Effluvia* of lighter Bodies: But to return from a Subject not at all scientific.

In the Analysis of Bodies the last Thing is always this Principle of Earth; and in their Composition it seems to serve as a *Basis* and *Foundation*, for the other Parts of the Mixture; and to it the Dryness, and Hardness of Bodies is in a great Measure to be ascribed.

ARTICLE V. Of SALT.

Salt, as has been said, is a mixed Body, but I chuse to say something of it in this Place after the other Principles; because, in all the common Solutions of Bodies, it is usually obtained entire; and a great Deal of Pains and Accuracy are required to decompose it; and reduce it to it's first Principles. It is also the Origin of Taste, Smell, and many other Properties of Bodies.

It may be defined to be a mixed Body formed by the Concretion of Fire, Water, and Earth, into a solid rigid Substance, soluble in Water and to be melted or run

by Fire. As it's Particles may be conceived to adhere by large Surfaces only, *Salt* cannot be friable or crumbled like Earth, but requires a considerable Force to separate it's Parts, which fly off from one another like those of Glass, with a sensible Noise. It becomes the Cause of Taste and Smell, because it's Particles terminate in strong Points, which vellicate the nervous Membranes of the Tongue and Nose.

Salt, which hath any Taste; is reckoned to be of three Kinds. 1. *Acid*. 2. *Acrid*, or *Alcaline*, and 3. Compounded of the other two, called in Latin, *Sal salsus*.

Acid Salt is supposed to be a Congeries of inflexible solid Parts of an oblong Figure, and pointed at both Ends. That its Particles are rigid and hard, appears from the Force, with which it divides and dissolves solid Bodies; and their Sharpness and Pungency are evident from the Effects they have upon the Tongue, different from the Corrosion of acrid Salts. *Acid Salt* is easily dissolved in Water and after this Solution, its Particles are equally dispersed through the Fluid, and have the same Motion with it. Hence it appears, that the Particles of both Substances have nearly the same specifick Gravity; and that the Motion of the aqueous Part is great enough to overcome the Cohesion of the Parts of Salt.

Concerning the Manner in which the
Par-

Particles of acid Salt are compounded of Fire, Water, and Earth, nothing, with Certainty, can be determined. Their Form however, is generally that of two Cones joined together at their Bases. This Configuration is not always the same in all acid Salts, but the Differences may all be reduced to *three*, the *nitrous acid*, the *muriatick*, and the *vitriolick*.

The Word *Alkali* is derived from *Kali*, the *Arabick* Name of a Plant from the Ashes of which a Salt is obtained proper for the making of Glass; and from thence it came to be used for all Salts got from the Ashes of Plants, and afterwards, for all Salts and other Substances whatever, that ferment with *Acids*.

Acrid or Alkaline Salt, seems to be a Congeries of spherical Particles, with rough prickly Surfaces, because of their great Disposition to Motion, and their corrosive burning Taste, the Points of their Surfaces are supposed to act on the nervous *Papillæ* of the Tongue, like so many Files; whereas *acid* Salt is only pungent. But then by these Points, a larger Surface is exposed to the Action of the Fire than could otherwise be, and thus the Particles of *alkaline* Salt are very volatile, or easily raised by a gentle Heat. The Origin of this Salt is probably from a certain Connection of acid Points and terrestrial Particles, because in many Operati-

ons of *Chymistry*, such Salts arise from the Mixture of *acid* Salts and *Earth*, as we see particularly in the Fermentation of fixed Nitre, and Fermentation of Urine. Nitre being distilled leaves a compound *fixed* Salt behind of the same Nature with *Sea Salt*; out of which by a nicer Distillation; an acid Liquor may be extracted, without any *volatile* Salt, or at least but a very small Quantity; but if the same Salt be previously fermented and then distilled, it yields a large Quantity of *volatile* Salt, and very little *fixed* Salt or *Acid*; because by *Fermentation* or *Calcination*, the acid and terrestrial Particles are intimately mixed, the acid *Spicula* entering the Pores of the Earth and so forming new *Moleculæ*, which are dense and close toward the Center, and prickly on the Surface, by the sticking out of the acid Points. Such are the Particles of *volatile* ALKALIES, of which if a great Number be joined together, they must cohere very strongly, by Means of their Points, and form *Moleculæ* of irregular Figures, in the Pores of which, watery, earthy, sulphureous, or acid Particles may be received and absorbed. Hence it is, that Salts of this Kind are seldom pure; and as they are very often filled with Particles of Earth: they resist the most violent Degree of Fire, and will sooner melt than be raised by it, this is the true Nature of all fixed *Alkaline* Salt, such as Salt of Tartar, or the

the Salts got from the *Ashes* of *Plants*, called lixivial Salts. If they be impregnated with sulphureous Particles they continue very volatile, and are raised by a small Degree of Fire; as we see in Salt of Urine, Harts-horn, and others got from Animals. Acrid Salts easily meet, when they are exposed to a moist Air; when they are thus melted, they become Lixivia, and take the Name of *Olea per Deliquium*. Thus you have Oil of Tartar *per Deliquium*,

Volatile *alkaline* Salts, diluted with Water are called volatile urinous Spirits, such as the volatile Spirit of Urine, of Harts-horn, Blood, and others.

The *Sal salsus*, or *third* Kind, is composed of ACID, and ALKALINE *Moleculæ* united together, and the Figure of it's Particles is chiefly owing to the Kind of Acid, that enters it's Composition. The Impression, which these Particles make upon the Tongue is more dull and languid than that made by *acid* or *acrid* Parts alone, because the *Moleculæ* formed by the Union of these are larger in Bulk, and consequently less disposed to Motion and therefore, tho' there is a greater Quantity of *Aculei* or Points, in one of these *Moleculæ* than in the former, yet their Bulk makes them less capable of entering the Pores of the Skin and vellicating the nervous *Papillæ*, than when they are in a disjoined State.

The Taste of these Salts is termed *Saline*, and varies according to the Difference of the *acid* or *Alkaline* Particles, which compose them, according to the Thickness of the *Spicula*, their Number, and other Parts which may be mixed with them.

That this is the true original of this Kind of Salts is evident both from the artificial *Composition* thereof, from acid and acrid Particles blended together, and from the *Resolution* of them into the Same. Thus by pouring Spirit of *Nitre*, of Sea Salt, or of *Vitriol*, on Salt of *Tartar* new Salts are produced exactly of the same Appearance with *Nitre*, Sea Salt, and *Vitriol*; and by analysing these three Salts, the essential Salts of Plants, *Sal Ammoniacum*, and others, an *acid* and alkaline Salt may be obtained, in some *fixed*, in others *volatile*.

ARTICLE IV. Of SULPHUR.

What the *Chymists* call Oil, or *Sulphur* is not a simple Substance, but a Body compounded of *Fire*, *Water*, *Earth*, and *Salt*. But we chuse to say something of it here in it's collected State, as it is most commonly separated thus entire in the Operations of Chymistry, and is with some Difficulty *resolvable* into it's *component* Principles:

It

It may be defined to be a *fluid, viscid, inflammable transparent Body without Taste or Smell*, (though by mixing it differently with Salts, these sensible Qualities are produced) *compounded of Fire, Water, Earth and Salt*. And it may be conceived to consist of many Flakes or *Flocculi*, each of which is again made up of small flexible Filaments formed of the four Principles before-mentioned, by Fermentation, whether that be in the Bowels of the Earth, or in the Bodies of *Plants*, and *Animals*. Thus an aromattick Plant growing in Water will by Distillation yield an Oil, which could never have been obtained from the Water in which it stood. And all Oils may by Art be resolved into *Water, Earth, and Salt*. From these Filaments variously con-creted arise the Flakes already mentioned, which are of different Thicknesses, and in the Pores thereof is lodged the Element of Fire, which also runs in Rivulets through their Interstices. Upon these depend the specifick Levity, Inflammability, and Fluidity of Oil; but as notwithstanding the intestine Motion caused by Fire, the *Flocculi* still adhere, in some Measure, together, this Fluid must be more viscid than any other.

From what has been said concerning the Nature of *Alkaline* Salts, and the Figure and Structure of the oily *Flocculi*, it is easy to conceive why all *Alkalies* dissolve Sulphurs. For since the *Alkaline* Particles are *spherical* and
prickly

prickly, they cannot enter the Interstices of the Flocculi without carrying away some of them from the rest, and thus by by Degrees, they dissolve them totally. But the dense, rigid and *conical* Moleculæ of the Acids being forced into these Interstices, increase the Density, and strengthen the Texture of the *Flocculi*; and from the Density of these and the acid *Spicula* mixed with them, arise the different Kinds of *Sulphurs*.

Sulphurs formed in the *Earth*, of Fire, acid Salt, Water and a very fine Earth are termed *Bitumens*. And *Bitumens* dissolved in a large Quantity of Water form the *mineral Oils*, or *Petrolea*. But if they are mixed with *Earth* and *Salt*, the *solid BITUMENS* are produced, differing from one another in Degrees of Purity, according to the Quantity or Grossness of the *Earth*, or different Degrees of Mixture. Thus *fossil* COALS, JET, AMBER, and the common *Bitumens* and *bituminous* EARTHS are produced. If there be but a small Quantity of *Earth* and much *acid* Salt, the common *mineral* Sulphur or *Brimstone* is formed.

If the *mineral* original *Bitumen* is joined to fusible *Earth* capable of Vitrification, it communicates to it a *metallick* Form; that is the *Sound*, *Brightness*, *Softness*, *Ductility*, and all the other sensible Qualities of METALS.

This Origin of *mineral* BITUMENS may be confirmed by many Experiments. If a Mixture of equal Parts of Oil of *Vitriol* and Oil
of

of *Turpentine* be digested together for a considerable Time, in a very gentle Heat, and afterwards distilled in a *Retort*, there come over first a *yellowish* Liquor resembling *Petroleum* both in Smell, and Consistence. What remains in the Retort is at first a *soft* BITUMEN, and afterwards turns into an *hard black Mass*, easily inflammable, and when burnt smelling exactly like *fossil* COAL.

But if the Distillation be continued, a *white, acid* Liquor will next be obtained, which by standing lets fall a *grey Powder*, which is true common *Brimstone*; a *yellow* Substance of the like Nature adhering likewise to the Neck of the Retort, what is left behind being a black, shining, light Substance, disposed in those disgregated *Strata*, like *Talck*, in which by the Help of the Loadstone, *Iron* may be discovered. Thus therefore all these Bitumens may be *artificially* produced; and the *Analysis* of the natural ones further confirms the Manner of their Formation.

Thus the *Chymists* have shewn, that Metals are nothing but *bituminous* SUBSTANCES, which have undergone a long *Digestion*; for by depriving them of their *Sulphur*, they are reduced to ASHES, and then to GLASS, this is easily seen in the *imperfect* METALS. For if any of them be exposed to a long Heat, and especially to the Rays of the Sun, collected by a large burning Glass, the sulphureous Principle flies off, and only a *Calx* or *Ashes* will be left

left behind, which *Ashes* in a more vehement Degree of Fire are presently *vitriified*, and by restoring the *Sulphur*, this *Glass* may be again reduced to *Metal*.

Again the inflammable Substances in *Animals* and *Vegetables* consist of a different Combination of the Principle of *Sulphur*, and *acid Salt*. For the *Oil*, or *Sulphur* in these is formed by a small Portion of *EARTH* joined to *ELEMENTARY Fire*, *acid Salt*, and *Water*.

This *Oil* when joined to an *acrid Salt* produces *GUMS*: When joined to a fine *Acid*, and a new Accession of *fiery Particles*, it produces *essential OILS*, and inflammable *SPIRITS*; but if the *Acids* are more gross by Reason of a larger Quantity of *Earth* joined with them, it forms *RESINS*. Their Property is to dissolve in *Spirit of Wine*. The Texture of real *Resins* is known from the artificial Composition of such Substances. By mixing *Spirit of Wine* with volatile *Spirit of Urine*, we obtain a mucilaginous Concretion, or thin *Gum*. *Oil of Olives* and *Salt of Tartar* melted together, make a kind of *Soap* or thick *Gum*: and if *Spirit of Wine* be digested for a long Time, with *Oil of Vitriol*, and then distilled, an inflammable *Oil* is obtained, resembling in Smell, and other Qualities, the *essential Oil of Plants*, a true *RESIN* being left behind in the Retort.

In *Animals* the same oleaginous Principle forms the *FAT*, and other *glutinous* or *gelatinous*

tinous Substances, these being first composed of an *acrid* volatile Salt, and Oil: as appears from their *Analysis*; but Fat is made of the same OIL, and *acid* SALT: For if Oil of *Olives* and Spirit of *Nitre* be mixed together and digested, a Substance will be formed in every Thing resembling the *Fat* of *Animals*.

Sulphureous Substances found in Bodies are either *fixed* or *volatile*. The *fixed* Sulphurs are either *solid*, such as FAT, RESIN and the BITUMENS, or *Fluid* as OILS. *Volatile* Sulphurs are such as fly off with a small Degree of Fire, and have an *Appearance* compounded of that of Oil and *Water*. Such are the inflammable Spirits obtained from the Flowers and Fruits of Plants.



C H A P. V.

What is meant by mixed Physiology, its Seat or proper Place belongs to the Pharmaceutick Part of Physick: Some general Rules for its Improvement, are all, that can be admitted here.

TH O' for the Sake of Order and Perspicuity it may be necessary to say something here in *general* of *mixed* or *comparative* PHYSIOLOGY, yet the Place for speaking of it more *particularly* belongs to the *Pharmaceutick* Part

Part of *Physick*, that being it's proper Seat in the Art of Medicine: For as much as this *comparative or mixed Physiology is employed in finding out, and applying the Properties, OR PHYSIOLOGY of other Substances to the Service, or Preservation of the Human Body.* If *Physicians* could discover the Changes, which all *mixed Substances* are capable of producing in the *human Constitution*; this with a sufficient Share of Discernment, how to apply these known Remedies properly, would carry the *Art of Physick* to as great an Height, as can be desired; and it might then, with more Modesty, be called a *Science*.

For making Discoveries in this Branch, some have thought it worth while to frame from the Figure, Colour, or other external Qualities of natural Substances certain Connections between their Virtues and some particular Parts, or Diseases of the human Body; and on these Principles have formed Systems of the Medicines proper for the Distemper incident to each Part. Thus they have pretended that there is a certain Analogy between Nutmeg and the Head; between the Leaves of Asarabacca and the Kidnies; between the Fruit of Anacardium and the Heart; between Leadwort, and the Teeth; between the Seeds of the Ash-Tree and the Tongue; between the Eagle-stone and a Fœtus in the womb; between Lapis variolarum and Pustules of the Small-pox; between

between the Blood-Stone and Blood ; between Crabs-Eyes the *Lapis Judaicus*, the Ladies Thistle, Teeth of the Boar, Jaws of the Pike or Jack and pleuritick Pains ; between the Roots of Figwort, or Roots of the *Carduus Hæmorrhoidalis*, and the Hæmorrhoids ; between Rhubarb, or Celandine and the Bile ; and so of others. But besides, that this Way of discovering the Virtues of natural Substances has been carried no great Length, it is in itself altogether absurd : The exterior Appearances of Things serving only to distinguish them from one another, but not to teach us the Effect they will have on any Part of the human Body.

Galen and his Followers endeavoured to deduce the Virtues of Medicines from their internal Qualities ; and their Fault lay altogether in this, that instead of the real Properties of Bodies, they substituted imaginary ones ; among which are to be reckoned, in many Cases, even their four primary Qualities, of *hot, cold, moist* and *dry*, on which all the rest depended. They had no other Way of discovering these in Bodies but by the Taste and Smell, which are far from being sufficient to inform us of all their Qualities, though they be in some Instances of very great Use ; thus we justly conclude that all bitter Plants are good for Digestion ; that all Acids are proper to restrain the violent Motion of the Blood ; and that all Plants of an aromattick Smell are agreeable

agreeable to the Nerves and animal Spirits ; the Taste and Smell of natural Bodies therefore are not to be neglected in searching for their Virtues, but only are to be kept within their due Bounds.

The modern Philosophers, in order to find out the Virtues of Bodies, have taken two different Methods ; the one is to trace them back to their component Principles, and the other to observe their Effects ; and both these Ways are still pursued by the Societies of learned Men, in *France, England, Germany, &c.* by chymical Analyses. The Principles of some mixed Bodies have been so far discovered, as that, by uniting these Principles again, or other Substances like them, they have produced Compounds exactly corresponding with those, from whence the Principles were obtained ; thus nothing is more easy than to decompose, and again to form Sea-Salt, Nitre, Vitriol, Allum, Brimstone, Bitumens, and many other mineral Substances, and by the Improvements, that daily continue to be made in Chymistry, it is to be hoped, that the Methods taken by Nature in the Formation of mixed Bodies, will at length be brought to Light. The royal Academy of Sciences have been at an immense Pains in analysing Plants likewise, by distilling them either fresh, or after they have been fermented, but have been able to discover very little Difference in their Principles. A large
Quantity

Quantity of Phlegm generally came over first, then an acid Spirit, an alkaline or urinous Salt, and lastly, a black fœtid Oil; from the Ashes of what remains is obtained a lixivial Salt, such as Salt of Tartar, which runs *per deliquium* in the open moist Air, or a kind of *Sal salsus*, as I have already defined it; such as that of the common Wall-Flower: Besides these Substances, which are got by Distillation from almost all Plants, there are others obtainable only from some of them, thus; from aromattick Plants, such as Lavender, Thyme, Sage, &c. a subtle, fragrant, essential Oil generally rises first: From a few Plants, such as Ellebore, Elleborastrum, Speedwell, Cresses and others, a very sharp, penetrating Spirit or Oil comes over with the first Degree of Fire, which is likewise obtained after the Plants have been fermented, but in a different Order. Sometimes the first Degree of Fire brings over an acid or urinous Spirit; sometimes an inflammable and very volatile Spirit; these are the few Elements or Principles obtainable from Plants; we are not however to imagine, that those which go by the same Name, are exactly alike in all Plants; the fixed Salts, for instance, got from their Ashes, being originally derived from some Acid, must differ from one another in various Plants, as much as Acids themselves do: For the same Reason the acid Spirits, volatile urinous Salts, and even essential Oil must be

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different;

different; and accordingly we observe that the essential Oil of Thyme, digested with Spirit of Sal Ammoniac, gives a violet or purple Tincture, which many other essential Oils will not do, wherein all these Differences precisely consist, has not hitherto been sufficiently cleared up.

From animal Substances we obtain a large Quantity of volatile urinous Salts, a thick Oil, very little fixed Salt, and still less acid Salt. The same Substances being boiled in Water, yield a Mucilage or Jelly, from which, by Distillation, the Principles already mentioned may easily be got. Tho' a perfect Knowledge of mixed Bodies has not hitherto been gained by all the Labours which the learned have undergone in Pursuit of this first Method; yet from the Analysis and Composition of Principles in Plants especially, some certain Rules may be laid down for investigating their Virtues; but the peculiar or specifick Virtues of some mixed Bodies have not hitherto been traced, because these, perhaps, depend either on some fine Particles which enter their Composition, and are too volatile to become the Objects of Sense and Experiment, or on the particular Disposition of the Parts of these Bodies hitherto undiscoverable. Upon one of these two Accounts it is, that we do not know, whence the emetick Quality in Antimony proceeds; why the Jesuits Bark cures Agues, why Opium is narcotick, why

why *Cantharides* affect the Bladder, why *Arsenick* is poisonous : But it is not impossible that when a sufficient Number of Observations, and Experiments have been made, all these Things may be brought to Light.

This brings us to the *second* Method used by modern Philosophers to discover the Qualities and Virtues of most Bodies, that of observing their *Effects* ; to compleat this a great Length of Time will be required, but I can with Pleasure affirm, that daily Advances are made in it ; this Method of Observation consists in mixing the Principles of Bodies obtained by chymical Analysis, with other Substances already known ; that by their Action on these, the Nature of them may be discovered, and likewise in mixing these Principles, or the Bodies themselves, from which they were got, with the Blood and other animal Liquors, or injecting them into the Vessels of living Animals, which Practice has afforded some very useful Discoveries.

The Substances with which the Principles of mixed Bodies have been mixed in these Experiments, are chiefly the Tincture of Heliotropium, the Tincture or Syrup of Violets, the Tincture of red Roses, the Tincture of Mallow-Flowers, the Solution of corrosive Sublimate, of Salt, of Lead, and Salt of Tartar, Lime-Water, an Infusion of Galls, the acid Spirits of Sea-Salt, Nitre, and Vitriol, Spirit of Wine, and others ; Substances, that abound

with acid Salts turn the blue Tincture of Heliotropium red, and this red is of different Degrees of Deepness, from Purple to the Colour of Bull's Blood, or of Fire, according to the Degrees of Acidity in the Subject. These Substances give likewise a red Colour to the Tincture of Violets, red Roses, and Mallow-Flowers; Bodies, which contain an acrid or alkaline Salt, turn the Tincture of Violets, Roses and Mallow Flowers green; if the Alkali be very weak, by mixing it with Spirit of Sea-Salt, a few Bubbles will rise; if stronger, the Agitation and Hissing will proportionably increase, and by a very strong Alkali a great Effervescence is immediately produced; a very weak volatile urinous Salt will, after some Time, change a Solution of corrosive Sublimate to the Colour of Opal: a stronger Salt of this Kind brings the same Solution to a pale Colour; and a very strong one to that of Milk, and gradually precipitates it; and the Quantity of volatile Salt being increased, this Precipitation will be made suddenly, and when it is very great, the Solution will be coagulated. A fixed Alkaline Salt turns the Solution of Sublimate to a yellowish Colour, and if weak precipitates it gradually, but if stronger, the Precipitation happens immediately, and the Solution acquires an Orange Colour; if there be any Vitriol contained in a mixed Body, it will turn the Infusion of Galls purple, or black; the least Portion of
Sea

Sea Salt contained in any Body, will make a Solution of Sugar of Lead foul, and whatever contains Sal Ammoniac, yields an urinous Smell, with the Solution of Salt of Tartar, or with Lime Water. Resinous Bodies give Tinctures to Spirits of Wine, and by mixing these with Water, the Resins will fall to the Bottom of the Vessel.

Experiments have likewise been made on the Blood, Serum, Bile, and other animal Fluids, by which it has been found that some Liquors coagulate the Blood in the Veins, and attenuate that in the Arteries; on the contrary, other Liquors attenuate, or coagulate the Blood in both equally; from whence it appears that there must be some Difference between the arterial Blood, and that in the Veins. The Juices of many Plants do not coagulate the Blood in the Arteries, among these are the Napellus, deadly Nightshade, and other poisonous Plants, black Ellebore, of the purgative Class; Wormwood, Angelica, Masterwort, Arsmart, and others, that may properly be termed salutary; the Juices of almost all Plants change the Colour of the Blood, and a few, as Sage, Mint, Bugle and Viper Grass turn it livid. Acid mineral Spirits turn the Blood to a thick black Coagulum, except Spirit of Sulphur, which seems to make very little Alteration, either in the Colour or Consistence; and *Borelli* affirms that he injected a Drachm of this Spirit into the

jugular Vein of a Dog, without any bad Consequence; but if Aqua Fortis, or any other mineral acid Spirit be injected in the same Manner, tho' diluted with Water, the Creature presently falls into Convulsions, and soon expires in great Torture; and on opening the Thorax, the Heart and Vessels are found to be filled with grumous Blood; a Solution of Salt of Tartar injected produces the same Convulsions, Tortures and Death. But here the Blood in the Heart and Vessels is not observed to be altered in its Consistence; by mixing the same Solution, or that of any other fixed Alkali with Blood, as it runs from a Vein, it seems to become more fluid; but at the Bottom of the Vessel thick turbid Fæces appear, which are likewise observed, tho' in smaller Quantity, when Blood is mixed with volatile urinous Spirits. Spirit of Wine presently coagulates the Blood very much, and being mixed with Serum turns it to the Consistence of the White of a boiled Egg; acid Spirits likewise coagulate Serum, but alkaline Spirits do not change it. The yellow Colour of the Bile is by Acids changed to green, by Alkali to a fainter yellow, and by Bitters to a deeper yellow. Acid Liquors cause an Effervescence with Bile, but alkaline Liquors do not; Spirit of Wine and all Acids thicken it. All acid Spirits change the Colour of Urine: Spirit of Nitre and the Phlegm of Vitriol turn it to the Colour of Blood, but
Spirit

Spirit and Oil of Vitriol do not change it so much. Acid Spirits do not make clear Urine turbid, or cause any Precipitation; but when Urine begins of itself to be turbid, they hasten this Change, and for the most Part likewise the Separation and Precipitation of its Contents. The same Liquors thicken for the most Part, the Sediment of Urine, and change it to a red Colour: sometimes, however, the Sediment being formed either spontaneously, or by the Help of Acids, shall, by the Addition thereof, be again dissolved; and afterwards a great Quantity of sandy or gritty Matter, of a reddish Colour, subside to the Bottom of the Vessel. Alkaline Salts turn Urine into a paler Colour, and thin its Sediment, especially volatile Alkali's; by which turbid Urine with a large Sediment, is sometimes rendered perfectly clear, all the Contents disappearing. Acids coagulate Milk, and separate it into Curd and Whey: Alkaline Salts hinder this Coagulation; but if one Part of Milk be digested in a slow Heat, with two Parts of a Solution of Salt of Tartar, the Mixture will become acid and transparent, and a few thick Clots will fall to the Bottom of the Vessel.

Some farther Observations have been made concerning the Effects of mixed Bodies thrown into the Bodies of Men, and other Animals; by which some Substances have been found hurtful to the one, and harmless

to the other. The same Quantity of corrosive Sublimate which will only make a Dog vomit, will kill a Man. The *Nux Vomica*, which may (as is believed) be safely taken by Men, is a poison to Dogs. And the same may be said of *Crocus Metallorum*. Jalap, which to Men is a very mild Purgative, throws Dogs into Convulsions, and inflames their Stomach. Many Substances are fatal both to Men and Brutes: Of this Sort are the Roots of the *Corona Imperialis*, the Roots and Leaves of Henbane; which, being eaten, raise an intense burning Heat, all over the Body, and disturb the Brain: The Fruit of the deadly Night-shade, which brings on a Delirium and Stupor, and sometimes a Sleep that ends in Death. The *Napellus* produces an intolerable Heat in the Throat and Breast, and as great a Cold in the Extremities, till Death relieves the Animal.

Many more Observations of this Kind might be added; but what has been already said, concerning the two Methods followed by modern Philosophers, in investigating Virtues and Qualities, of natural mixed Bodies, is sufficient to demonstrate the Importance and Advantages of both, and to direct us in continuing the same Enquiries concerning the Effects of all Substances on the Human Body, and the Manner in which they are brought about; as will appear by the few following Examples.

Let

Let us suppose that the Virtues of the common Burdock are to be found out. The first Enquiry is what the Leaves will afford by chymical Analysis. From five Pounds of these Leaves are obtained a Pound and Half of insipid Phlegm, two Pounds of acid Liquor, eight Ounces of an alkaline urinous Liquor, a Drachm of concreted alkaline Salt, three Ounces of thick Oil, reckoning both what comes over; and what is burnt away by calcining what remains at the Bottom of the Retort; an Ounce of fixed Salt, and the same Quantity of pure Earth. From this Analysis, it is probable that Burdock Leaves before they are analysed, contain more of a watry Liquor than of any other Parts; that this Liquor is plentifully stored with a Salt of the ammoniacal Kind, composed of the acid and volatile urinous Parts joined together; that the fixed Salt did not exist in the Plant, but that the essential Salt is, by the Force of Fire, converted into it, in the same Manner as the Tartar of Wine, which is nothing but the earthy Part of that Fluid, overstocked with acid Salt, is by Calcination turned to a fixed Alkali. Again, the Leaves of this Plant are of a bitter Taste, and their Juice does not change the Tincture of Heliotropium; which shews, that the acid Salt, in them is so intimately combined with the alkaline, thick, sulphureous, and earthy Parts, as to have no separate Action in that State.

State. These Leaves when burnt, flash a little, from whence it may be concluded, that the Salt, they contain is of the nitrous Kind. Therefore the chief Virtues of Burdock Leaves are owing to the great Quantity of ammoniacal Salt contained therein, mixed with a smaller Proportion of nitrous Salt and Oil, and the Effects, which they are observed to produce, are exactly answerable to this Conjecture about the Composition of them; for they are diuretick, sudorifick, pectoral, anti-hysterick, and proper in Fevers.

In like Manner the Leaves of Agrimony, in the Quantity of five Pounds, being chymically treated, yield four Pounds of an acid and almost austere Liquor; two Ounces of thick Oil, six Drachms of fixed Salt, and an Ounce of insipid Earth. From this Analysis it appears, that this Plant contains very little Salt of the ammoniacal Kind, since no concrete urinous Salt is got from it; but the acid Salt, wherewith it abounds, joined with Earth forms a Concrete, resembling Tartar, or Salt of Coral, combined with a large Proportion of Sulphur. Moreover Agrimony has a saline Taste, a little astringent and acid, and its Juice turns the Tincture of Heliotropium to a faint Red; so that its astringent and aperitive Virtues seem both owing to the same austere Salt; for though these Effects are contrary to one another, yet they often flow from one and the same Principle,
the

the strengthening of the weak and lax Fibres of the solid Parts. Experience shews, that Agrimony has the Virtues which are supposed to arise from its Composition; for it is astringent, detergent, resolvent, vulnerary, and aperient.

The Roots of Bistort and Silverweed are astringent and stop the Flux of Blood, and, accordingly are found to contain an aluminous Salt, joined with Sulphur; for by Analysis, they yield an acid Phlegm, some Oil, and a little urinous Liquor, a ponderous *Caput Mortuum* remaining; and as they are likewise of a styptick Taste, it is probable that the acid Salt and astringent Earth, wherewith they abound, are united in a Concrete of an aluminous Kind, upon which the Effects depend.

After the same Manner, from the Analysis of the common Mallow, its Manner of acting may be discovered, from five Pounds of the Leaves and Roots, are obtained Four Pounds of Phlegm, two Ounces of urinous Liquor, about forty-eight Grains of concrete urinous Salt; four Ounces of Oil, partly fluid, and partly thick; six Drachms of fixed Salt, and an Ounce of Earth. Whence it appears that this Plant contains an ammoniacal Salt joined with Earth; and that the large Quantity of Oil is, by its Union with the acid Phlegm, converted into a Mucilage, which, tho' it be destroyed by the Fire, is,
in

in the Plant itself, the Cause of its emollient and lenient Effects. Oil, long beat up with Water and fine Earth, turns to a Mucilage; especially if a small Quantity of any acid Spirit be thrown into the Mixture. The Juice of this Plant, taken either inwardly or by Clyster, is laxative; both as it moistens and softens the hard Excrements, and as it relaxes the Fibres of the Intestines, dried by Heat, and so become too tense and rigid for their natural Actions.

From five Pounds of the Leaves of common Toadflax, we get three Pounds of acid Phlegm, an Ounce of urinous Liquor, nine Ounces of Oil, three Drachms of fixed Salt, and an Ounce and half of Earth. This Plant therefore contains but a very small Quantity of ammoniacal Salt, because no concrete urinous Salt followed the second Liquor. Its natural Salt comes nearest to Tartar, or to the *Terra Tartari foliata*. The whole Plant is of a saline herbaceous Taste, neither does its Juice at all change the Colour of the Tincture of Heliotropium. The Leaves being bruised between the Fingers have a disagreeable Smell, something like that of Elder. These Observations, compared with the Analysis of the Plant, shew that it abounds with a fine Oil resembling the sulphurous Part of Opium; whence it must be anodyne and resolvent, as Experience shews it to be.

Five Pounds of Earth-Worms yield a
Pound

Pound and half of urinous Phlegm, and the same Quantity of urinous Liquor, much more penetrating than the former, five Drachms of concrete urinous Salt, seven Ounces of Oil, a Pound of Earth, and two Drachms of fixed Salt; hence it is plain, that these Animals abound with urinous Salt, involved by Sulphur in a large Quantity, and mixed with a very small Proportion of Acid, much after the same Manner as Scot. They contain likewise much Water and Earth. If they are kept long enough to putrefy, and be afterwards dried, by being washed with Water, this Mass will yield a Salt that flashes with Charcoal; which shews that the ammoniacal Salt in them resembles that Kind of Sal-Ammoniac, which is made with the Acid of Nitre, and an urinous Spirit. It is therefore easy to conceive, that, when externally applied, they have an incisive, emollient, and detergent Virtue, and that, inwardly taken, they are diuretick and aperient.

From what has been hitherto said, concerning the Manner of discovering the Virtues of Medicines the following Rules, or Axioms, may be laid down.

1. Nothing is of greater Consequence in investigating the Principles by which mixed Substances act on the human Body, than the Observation of the Analogy, that there is between them and Things commonly known; for it is only by comparing Things unknown with

with those, that are known, that we come to discover their Virtues. Thus for instance, it is much more proper to attribute the Effects of mixed Substances, to the Sal-Ammoniac, Tartar, Allum, Vitriol, Nitre, Sea-Salt, essential or foetid Oil, contained in them and such like; than to have recourse to Acids and Alkali; Fire, Air, Water, and Earth, which are never obtained pure from any Mixture; or to Heat, Cold, Dryness and Moisture; by which the Properties of no Body can ever be discovered.

2. All animal Substances contain a gelatinous Fluid, which is easily extracted from Skins, Flesh, Bones, Horns &c. by long boiling them in a large Quantity of Water. This Juice differs but little from Blood and Lymph, and is chiefly composed of Sea-Salts Sal-Ammoniac, and Oil. If these three Principles are separated by the Force of Fire or by Fermentation, a large Quantity of alkaline urinous Salt, and also of thick Oil, is obtainable; but nothing like an acid Salt discovers itself, except in fresh Urine and Sweat; it being either all changed into an alkaline urinous Salt, by its Combination with Sulphur, or remaining locked up in the other Parts, in Form of fixed Salt, of which a very small Portion is obtainable by Fire. Insects however, such as Worms, Ants, &c. are to be excepted; from which a small
Quantity

Quantity of nitrous acid Salt may be got by Distillation.

3. It is not to be thought that all acrid urinous Salts are exactly alike: some of them approach to the Nature of Sea-Salt, as volatile Salt of Urine, as appears by the Taste; neither is that so caustick as the Salt of Blood. Salt of Hartshorn is formed into little Branches something resembling Horns; but Salt of Urine, when crystallized, runs into little Cubes. The same Observation is to be made concerning Oils; for tho' all animal Oils abound with active Parts, by Virtue of which they are successfully applied to strengthen weak and paralytick Joints, to resolve Obstructions in the Nerves, and attenuate the Fluids of the Body; yet some of them are not only active, but caustick and irritating to a great Degree, such as the Oil of Ants, Cantharides, &c.

4. All vegetable Substances have an essential Salt, compounded of an acid, an urinous alkaline Salt, Earth and Oil, as appears by their Analysis.

5. Mixed Substances which yield much acid Phlegm, and Earth, and have not a styptick Taste, contain a Salt like Tartar, or Cream of Tartar; and which has the same Virtues with these.

6. If to the Parts just mentioned a styptick Taste be joined, then the Salt they contain is
of

of the aluminous Kind, and its Virtues the same.

7. Whatever gives a blackish or purple Colour to an Infusion of Galls, contains a Salt like Vitriol.

8. Whatever flashes with burning Charcoal, abounds with a nitrous Salt, or something near a-kin to it. Such Plants are Pellitory of the Wall, Marygold, &c.

9. Plants, that contain a large Quantity of viscid, mucous Juice, by which the other Principles are involved, act chiefly by Virtue of such Mucilage, much after the Manner of Gum Tragacanth.

10. There are some Vegetables whose Action does not so much depend on their essential Salt, as on the fine Oil they contain, which is from thence termed their essential Oil. Whatever Plants have a strong aromattick Smell, abound with this Oil; and they yield it when distilled with a large Quantity of Water.

11. Substances, that have a disagreeable, foetid Scent act by Virtue of the foetid essential Oil, they contain; such are Rue, Castor, &c.

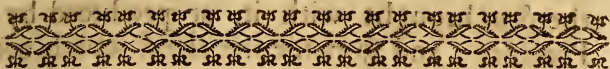
12. Substances that smell like Opium, are Lenient and Anodyne.

13. After all the chymical and physical Trials, which we make, in order to discover the Nature and Action of mixed Substances, we are not immediately to use them in Physick,

sick, till we are sure that no Inconveniency will attend them, either from their being already made use of by Physicians of our own Time, or from the Authority of Writers that deserve to be believed, or lastly from frequent Experiments made with them upon other Animals.

14. The Rules already laid down may undoubtedly be of great Use in discovering the Properties of mixed Bodies; but there are other Medicines termed Specificks, whose Manner of acting on the human Body cannot be discovered by any Means hitherto known. Most of them have been found out by mere Accident, and more may still be found by an accurate and unwearied Observation of all that happens to Men or Brutes, both healthful and diseased, from the Use of different Substances, either as Food, or Physick. The Necessity and Usefulness of such Observations cannot be too much inculcated on Students in Physick, as being a more sure Way to improve and extend that divine Art, than the most subtle abstracted Reasonings of the greatest Theorists that ever lived. The antifebrile Virtue of the *Peruvian Bark* was discovered by chance. Some Trees which bear it being blown into a Canal, or Pool of Water, lay there till the Water acquired so bitter a Taste that no Person could drink it; one of the neighbouring Inhabitants, however, being seized with a violent hot Fit of

an Ague, and finding nothing else to quench his Thirst, ventured upon a large Draught of this bitter Water, which cured him of his Fever, and Thirst at the same Time. This being made known by him, for the Benefit of his Neighbours, the same Water was used by many with equal Success: But the Trees coming at length to rot, the Water lost its bitter Taste and Virtue likewise; but upon a diligent Search after the Cause of this Bitterness, they at length traced it up to the Bark of these Trees; which has ever since been made use of, as the most certain Remedy for intermitting Fevers of all Kinds.



PHYSIOLOGIÆ *humanae, sive Propriæ*
STADIUM PRIMUM;

O R

THE FIRST STAGE

Of Human, or Proper

PHYSIOLOGY.



CHAP. VI.

Of the different Temperaments of human Bodies, and how they are discovered by the outward Appearance.

THE *Temperament* of an *human Body*, according to the Notion of the antient *Physicians*, admitted of divers Denominations. As to its *Origin* it was threefold; *innate, adventitious, or actuate*. The first was supposed to be that *Habit, Crasis or Disposition* which existed in the *Body* before the Ar-

rival of the *Soul*: the second was that, which the *Soul* brought with it, or produced by its Presence; and so made the *third*, which commenced upon the *Union*, or Association, and continued for that Time, and no longer.

This Account however seems not a little puzzled. For if by the *Soul*, they mean the *rational Soul*, that, being *immaterial*, is not capable of entering into *bodily Mixtures*: We do not know that it brings with it *Heat* any more than *Cold*; nor has it at all DOMINION over the *vital Functions*, whatever it may have over *muscular Motion*, or some few such *mechanic Powers*. The chief Business of the *animal Oeconomy*, however, is transacted without its Intercourse, without its Knowledge, and without its Leave; and therefore this Sort of *Soul*, let it come when it will, can make no *Alteration* upon its *Accession*, in the *innate TEMPERAMENT* of the Body.

But if by *Soul* they mean Faculties of *Life* and *Sense*, as they appear in the *Fœtus* before the Birth: why then this *Soul* of *Life*, or *living Soul*, is *coeval* with the Body; it was born, nay it was begotten, with the Creature, and no way adventitious after. There is no such Gradation then from the *innate* to any *adventitious Temperament*, which is supposed by these Writers to take Place upon the *Ingress* of the *Soul*: Since the Sort of *SOUL*, which they represent to be *adventitious*, is really a *Soul ex traduce*, derived from the
Parents

Parents at the Moment of Conception, and one and the same in *Time*, if not in *Nature*, with their *innate* Temperament of the Body, which they imagine to be *antecedent* to it.

But though I have made Objections to this *Distinction*, as having no Place in the real State of Things, I have nothing to say in Opposition to the rest: this general Temperament, whether *ex traduce*, and so made all at once upon *Conception*, according to my Hypothesis; or *compounded* at *different Periods*, according to theirs, will be subject alike to the usual Denominations of the *bilious*, or *choleric*; the *sanguine*; the *phlegmatick*, or *melancholick*; or any other such CHARACTER, as from Appearances Physicians are accustomed to impose upon it. The preceding Division is said to correspond to the four ELEMENTS, and the four HUMOURS. *Choler*, being hot and dry, answers to the Element of *Fire*; hence it is, that *bilious* People are *hot* and *dry*: after the same Manner Physicians used to form a Judgment, and give *Denominations* to all the rest.

There are VARIOUS WAYS of discovering the different *Tempers* of the human Race; for instance, by their *Touch*, by their *Blood*, by their *Hair*, by their *Colour*, &c. but, as some say, by their *Behaviour*, best of all. For instance, *bilious* People are naturally *quick*, *restless*, and of *penetrating* Wit: *phlegmatick* People, on the contrary, are in their MOTIONS

slow and heavy, and in their UNDERSTANDING dull and stupid.

BOERHAAVE has treated more largely on the Division of Temperaments, and given a particular Description of each; taking them separately, according to the received Number of the Elements and Humours, he makes their Number eight: *hot, cold, moist, dry, bilious, sanguine, phlegmatick, atrabiliary or melancholick.*

The SIGNS of an *hot* Temperament are yellow Hairs, strong, and in great Abundance all over the Body: a Redness in the White of the Eye, near the lachrymal Caruncles: Colour very red in the Face, Lips and Mouth: the Body thin, active, strong and hot: their Pulse is great and quick, and their Anger thunders off, and discharges itself in a short and sudden Passion: their Vessels are commonly robust and contracted; bowels strong; Humours much in Motion, thick, and sharp. To these, moistening, diluting, temperate Things are very profitable, and all hot Things extremely hurtful. The Signs of the *cold* Temperament (which is also moist) are all contrary: as Baldness, thin Hairs, pale Complexion, the Body rather gross and heavy, weak, cold, and much inclined to swell: a pulse smaller and slower than ordinary; Insensibility and Fear. In these the Humours are soft, watery, phlegmatick, lazy; the Solids lax and shrunk. Here strengthening and warming

warming Things are useful; as all cold, watery, relaxing Things do Hurt. A *dry* Temperament is discerned by nearly the same Symptoms as the *hot*, especially if there be Leanness withal; and therein too the same Sort of Things relieve and hurt. There is the same Similitude between the *humid* and the *cold*. The *bilious* Temper is known by the Quantity of Hair, black and curled; by the Hardness and Leanness of the Flesh, the brown Colour of it, the large Veins, great Pulse and quick; the Obstinacy and Anger of the Person. This Habit is encreased by hot and dry Food, and relieved by such as is moistening and cooling. The *sanguine* Temper is distinguished by thin Hair, of a yellow Colour inclined to white, or else a brown; by soft Flesh, and a pretty deal of it; large blue Veins distended with Blood, a rosy Colour, by some Degree of Passion in the Temper, and by a flexible and easily persuaded Inconstancy. This Constitution is relieved by a temperate and evacuating Regimen, and hurt by one that heats or strongly stimulates. The *phlegmatick* Temperament is known by the uncommon Baldness of the Skin; by the white Hairs, and those thin, and growing very slowly; by a white, bloated, soft, fat Habit of Body; small Veins, and those scarce appearing. Persons of this Stamp are near a-kin to those of the cold Temperament, and therefore are hurt and relieved in much the same

Manner as is there described. Lastly, the Signs of a *melancholic* Disposition, are Baldness; very black Hair, where Hair remains; great Leanness, great Dryness of the Flesh, its Colour very dark; a dilatory Temper, yet withal constant; Anger that never forgets the Object of its Resentment; great Penetration and Intelligence. The Vessels here are streight, or astringed; strong and lean: the Humours thick and tenacious, very much mixed, and not easily to be separated, or changed. Things that are hot, dry and acrid, are in this case detrimental; while those, which refresh or relax, that soften and gently resolve, are sure to give Relief.

So much depends upon Temperament, that some Physicians, have imagined even the *Difference of Sex* to proceed from thence. This I think may be disputed, because the *Form of the Animalcule* may more probably be determined by something else: thus far however may be allowed them, that beside their personal Particularities, there is generally a Temperament peculiar to either Sex. Upon this Cause likewise, namely Temperament, depend Health and Sickness, our Age or Time of Life; during which, by the Action of the Heat upon the Moisture, the Constitution of the Body, apart from Distempers, is manifestly changed: Alterations continually ensue from the very Time of Man's Generation. The principal Stages of his Being are variously

variously numbered. *Hippocrates*, in his Book *de Carne*, reckons *seven*; others, *four*: that is to say, Youth, (which comprehends the Infant, the Child, the Boy, and the Youth, properly so denominated) extending to the Age of twenty-five or thirty Years; Manhood, from thence to thirty-six or forty; Middle-Age, from thence to forty-five or fifty; lastly Age itself, which may be subdivided into the vigorous, and the decrepid, which latter ends in Death. Every Age has its peculiar Temperament: that of Infants is very warm and very moist; that of decrepid Age, very cold and very dry: which is estimated not so much by the Number of Excrements, as by the Substance of the solid Parts, which is very dry. There has been no small Controversy about the Temperament of Youth; whether it be as warm as that of Boys. *Galen* is of Opinion, that the Heat in both is equal: yet Reason would persuade one, that in Boys it should be rather more intense; yet it is kindly withal, and rather more replete with Vapours: and that in Youth it should be less intense, though sharper at Times, and more biting: for which Cause, People of this Class are so often subject to burning Fevers. The Preservation or Destruction of Health, thro' all these Periods, depends greatly upon a Person's Manner of Life and Exercise, and the Things which are called the Non-naturals: so if you have Regard only to their Years,
you

you will see some young Men with the Temperament of old Age, and old Men again enjoying a youthful Habit: But though it sometimes happens that Constitutions, by good or ill Management, may wear these different Appearances; yet strictly speaking, notwithstanding any temporary Renewals, Amendments, or Recoveries, the radical Moisture, and vital Heat, must by the Course of time, and successive Decay, grow worse and worse; the Heat being weakened and diminished, by the continual Attrition and Digestion of Aliments, as well as by other Accidents; and the Moisture, by perpetual Evaporation: so that inevitable Death, in the course of Things, after the best Management, must appear at last.

Before I conclude this Chapter, it is necessary to observe, that as the great Variety of Temperaments requires a great Variation of the *Qualities* of Medicines prescribed to different Persons; so a Difference of Age requires a proportionable Difference in the *Quantity*, even of the same Medicine administered, at different Periods, to the same Person, which is to be regulated generally by the Prudence of the Physician regarding the Increment and Decay of Strength.

C H A P. VII.

The External View of the Parts of an human Body.

The Division of the Body.

THE Body is divided into four principal Parts, which are, the Head, the Thorax, the Abdomen, and the Extremities, viz. the Arms and Legs.

The External Parts of the HEAD.

The External Parts of the Head, or upper Cavity, are, the Face, and the *Clava*, or hairy Scalp. The Parts of the Face, are, the Brow, the Ears, the Eyes, the Cheeks, the Nose, the *Philtrum* and its Sides, the Mustaches, the Lips, the Mouth, and the Chin. The Parts of the hairy Scalp, are, the *Sinciput*, or Forehead, under which lieth the *Os Frontis*: It reaches to the *Βρέγμα*, or Meeting of the coronal with the sagittal Suture. The *Vertex*, or Crown of the Head, is where the Hairs turn, as it were, round a Point; and from thence to the first Joint of the Neck is the *Occiput*, or Head behind. The Temples are the Sides of the hairy Scalp, under which are the *crotophite Muscles*.

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Muscles, the *Ossa Petrosa*; they reach to the
the *Suturæ Squamosæ*.

Of the Ear.

The External Ear is divided into two Parts, of which the upper is called *Pinna*, or the Wing; the lower, *Fibra*, or Lobe. The Parts of the *Pinna* are the *Helix*, which is the outward Circle or Border of the Ear; the *Anti-helix*, which is the Semi-circle within the other: The lower End of the Semi-circle makes a little Prominence, which is called *Anti-tragus*; because there is another Prominence just opposite to it, which is called *Tragus*, by Reason of some Hair that is upon it. The Cavity made by the Extremities of the *Helix* and *Anti-helix* is called *Concha*: The Hollow in the Middle of the Ear is called *Alvearium*; it has a Hole which leads to the *Tympanum*, named the *Meatus Auditorius*.

Of the Eyes.

The External Parts of the Eyes, are the *Supercilia*, or Eye-Brows, the *Canthus Internus*, or the great Angle, where the *Caruncula Lachrymalis* is; the *Canthus Externus*, or the little Angle, which is the farthest from the Nose; the *Palpebræ*, or the upper and lower Eye-lids; the *Cilia*, which are little
Cartilages

Cartilages on the Edge of the Eye-lids; the Hairs planted upon the *Cilia*, in Form of a Pallizado; the *Puncta Lachrymalia* which are two little Holes near the big Angle of the Eye. The Orbit is a Cavity made by the Bones, in which the Globe of the Eye is contained, with its six Muscles; the *Tunica Conjunctiva*, which is the White of the Eye; the *Cornea*, which is the transparent Part of the Eye; the *Iris* or Rain-bow, in the Middle of which is the *Pupilla*, or Sight.

Of the Nose, Lips, &c.

The Nose has its *Spina*, or Ridge, which is long. The *Acrorifion*, which is cartilaginous, and reaches from the End of the Spine to the *Globulus*, or Tip of the Nose. The Nostrils are the Passages into the Nose. The *Alæ*, or Wings of the Nose, are the Sides of the Nostrils. The *Columna* is the little fleshy Portion which reaches from the Tip of the Nose to the *Philtrum*; it divides the Nostrils. The *Philtrum* is the Hollow which divides the upper Lip immediately under the Nose. The Cheeks reach from the lower Eye-lids to the Lips. The *Mentum*, or Chin, is the Fore-part of the lower Jaw. The lower Jaw reaches from the two Ears to the Chin, inclusively. The Lips are the musculous Flesh at the Entry of the Mouth; their external Part is called *Prolabium*, and that

that which is tinged red, *Prostomion*. The Gums are the Flesh which covers the lower Part of the Teeth.

Of the Neck.

The Neck reaches from the Head to the *Claviculæ* or Chanel Bones. Its Parts are the *Jugulum* or Throat, which is its Fore-part, along which descends the *Trachea Arteria*, or Wind-pipe, and the *Oesophagus*, or Gullet. The Eminence which appears in the upper Part of the Throat is called *Pomum Adami*. The *Cervix*, which is the hind Part of the Neck; its upper Part is called *Lophia*, the middle *Fossa*, and the lower *Epinis*. The *Parotides* make the upper and lateral Part of the Neck, *Terthra* the middle, and *Paralophia* the lower.

Of the External Parts of the Thorax, or Middle Cavity.

All that lies betwixt the Basis of the Neck, and the *Diaphragma*, or Midriff, that is, down to the last Ribs, is called the *Thorax*, or Chest. The Fore-part of the *Thorax* is called the Breast; in it are the *Claviculæ*, or Chanel-Bones; and the *Sternum*, or Breast-bone, which is in the middle; it begins at the *Claviculæ*, and terminates in the *Cartilago Xiphoides*, or Sword-like Cartilage. Under the *Sternum* lies the *Mediastinum*,

num, and the Heart in its *Pericardium*. The *Mammæ*, or Breasts, are two round Tumours, which appear upon the Fore-part of the Chest, under which are situated Part of the Ribs, the *Pleura*, and the Lungs: There stands upon their Centre a little Protuberance called *Papilla*, or Nipple, which is encompassed with a reddish Circle, called *Areola*. The Hollow in the Middle of the Breast, below the Breasts, is called *Scrobiculus Cordis*. The hinder Part of the *Thorax* is called the Back, composed of twelve *Vertebræ*, or Joints, and two *Scapulæ*, or Shoulder-Blades, which are the two upper Parts of the Back on the Sides of the *Vertebræ*. The lateral Parts of the *Thorax* are called *Peristerna*.

Of the External Parts of the Abdomen, or lower Belly.

The lower Belly extendeth from the *Cartilago Xiphoides* to the *Os Pubis*; the fore-part is called *Abdomen*, and the hinder-part the Back-side. The *Abdomen* is divided into upper, middle, and lower Parts. The upper reaches from the *Cartilago Xiphoides*, till within two Fingers Breadth above the Navel; it is called *Epigastrium*, and its two Sides *Hypochondria*. The Right covers the greatest Part of the Liver; the Left the Spleen, Part of the Stomach, and *Colon*. The middle Part of the *Abdomen* is only two Fingers Breadth above, and as much below the

the Navel ; it is call'd *Regio Umbilicalis* ; its Middle is called *Umbilicus* or Navel. Under the Middle of this Region lies all the *Intestinum Jejunum*, and Part of the *Ileum*. The Sides of this Region are called by *Glisson*, *Epicolicæ*, because they cover the *Colon*. Under the Right is contained the right Kidney, Part of the *Colon* and *Jejunum*: Under the Left is contained the left Kidney, with Part of the *Colon* and *Jejunum*. The lower Part of the *Abdomen* reaches from the umbilical Region to the lower Part of the *Os Pubis* ; it is called the *Hypogastrium* ; it covers the Bladder, Womb, and the *Rectum* or Straight-gut. The lower Part of the *Hypogastrium* is called *Pecten*, or *Regio Pubis* ; its Sides *Inguina* or Groins. The Sides of the *Hypogastrium* are called *Ilia*, either because they contain almost all the Gut *Ilium*, or because they terminate at the lower Part of the *Os Ilium*. The *Inguina* or Groins are below the *Ilia*, where there is a Part of the Muscle *Cremaster* with the Productions of the *Peritonæum*. The hind Part of the *Abdomen* is called the Back-side ; it reaches from the last Ribs to the Extremity of the *Os Sacrum*. It is divided into two Parts. The upper is called the Small of the Back, its Sides the Loins ; the Middle of the lower Part is called *Radius* ; as its lower End is the *Anus*, and its Sides the *Nates* or Buttocks. The *Perinæum* is the Space between the *Anus* and the Privities.

Of

*Of the External Parts of the Arms, Fore-arms
and Hands.*

The Arm is from the Joint of the Shoulder to the Elbow, which is the Place where we bend our Arm. The Fore-arm is from the Elbow to the Wrist or *Carpus*. The Hand is all that, which is betwixt the Wrist and the Ends of the Fingers. The Parts of the Hand are the *Metacarpus*, which is from the Wrist to the Root of the Fingers; the Outside, which is the Back of the Hand; and the Inside, which is the Palm of the Hand; the *Mons Pollicis* is the fleshy Part of the Hand nigh the Thumb; the Finger next the Thumb is called the *Index*, or Fore-finger, then follows the Middle, the Ring-finger, and the little one. Upon the Extremities of the Fingers are the Nails; the white Spot, which is at the Root of the Nails, is called *Onyx*.

Of the External Parts of the Thigh and Leg.

The Thigh is from the Haunch to that Joint of which the Fore-part is called the Knee; the Back-part the Ham.

The Leg is from the Knee to the *Tarsus*; its Fore-part is called the Shin, and the Back-part the Calf of the Leg: The Eminencies, which are at the Extremity nigh the

Tarsus, are called the outer and inner Ankles of the Foot: The *Tarsus* is from the Ankles to the *Metatarsus*, or Breadth of the Foot, which goes to the Root of the Toes: The upper Part of the Foot is called Instep; the under Part the Sole of the Foot: the Toes are five in Number, with their Nails.



C H A P. VIII.

Of the Component Parts

THough *Hippocrates* (6 *Epidem. Contex.* 7.) divides the human Body into three Portions, and makes the Parts to be either, *contained*, *containing*, or *moving*; yet others are more strict in the Use of the word *Part*. So that the Things *contained*, by which are meant the several Humours, and likewise the Things that move, which the above mentioned Author calls *ὀρμῶντες*, or *impetum Facientes*, and by which he understands the *animal* or *vital* Spirits, as they are alike destitute of Form and Figure, are seldom allowed the Title of *Parts* by later Writers. For though Life and Health cannot subsist without the Humours of the Body, yet it does not follow in their opinion, that the Blood, or any other Humour, which is as necessary as that, to the Support of the whole, can

can yet be properly called a Part. They cannot deny them however to be necessary Contents, and where is the Difference between Parts, and necessary Contents? This Distinction seems to be rather *technical* than *real*; but since it is received, I shall follow Custom, and define a Part to be *a solid Body, cohering with the whole, endued with Life, and framed to perform some Office, or Function.*

A Part then must first be *solid*; for which Reason, Humours cannot be reckoned among the Parts. Secondly, it must have *Life*; and therefore the Excrescences, as the Hairs, and Nails, &c. are not to be accounted Parts. Thirdly, according to this Hypothesis, one Part must not nourish another; and so the Blood, Fat, and Spirits are not Parts. Fourthly, it must have Circumscription. Fifthly, it must be united with the whole; both in respect of Matter, and Form: Sixthly, it must have some Function or Use. The principal Differences of Parts are taken either from their Matter, or End. From their Matter, Parts are said to be *familiar* or *disfamiliar*. A *familiar* Part is that, whose Particles are of the same Substance, and Denomination throughout: as every Part of Bone is Bone. It is otherwise called a simple Part. Of simple Parts they used to reckon ten; the Skin, the Flesh, a Fibre, a Vein, an Artery, a Nerve, a Ligament, a Cartilage, a

Bone: To which may be added a Tendon: For it is distinct from these, and the Substance of it simple, and without any Composition, and then the old Couplet of Latin Verses may stand corrected thus,

*Cartilago, Caro, Membrana, Arteria, Nervus
Vena, Ligamentum, Cutis, Os, cum Tendine, Fibra.*

Of the former simple Parts some are simple indeed, and these are in number seven; the Skin, a Membrane, the Flesh, a Fibre, a Ligament, a Cartilage, a Bone. The rest are only simple to the Eye, or Sense; and not to Reason: for a Nerve, in particular, is composed of many Filaments, covered with a double Membrane, made of the *Dura* and *Pia Mater*.

Of the *simple* Parts some are called spermatical, as a Bone, a Cartilage, a Ligament, a Membrane, a Fibre, a Nerve, an Artery, a Vein: these are supposed to be made of the Seed, and it is to be observed, that if they be cut in two, or broken, they are not to be regenerated, nor truly united, but only joined by a Callus.

Others are sanguineous, being supposed to be made of Blood, and these may be regenerated; as is apparent in muscular Flesh. As for the Skin it seems to be partly spermatical, and partly sanguineous. For though in adult Persons a Wound in it is not to be healed
without

without a Scar: yet, in Boys, it has been observed to be closed with a true and proper Skin.

A dissimilar Part is that, whose Portions are neither of the same Substance, nor the same Denomination, as a muscle; in the which, are Flesh, nervous Fibres, and a Tendon: It is otherwise called a Compound and an organical Part.

In an organical Part there are generally four things observable. As for Instance, in the Eye, there is first the chief Particle, by which the Action, namely Vision, is performed, which is the crystalline Humour. Secondly, that Particle, without which the Action cannot be performed, as the optick Nerve. Thirdly, what furthereth the Action, as the other Humours, Membranes, and Muscles. Fourthly, that by which the Power of Action is fenced or preserved, as the Eyelids.

Of organical Parts likewise there are reckoned four Degrees. The first is made only of the Similars, as a Muscle. The second receiveth the first kind of organical Parts, and other Similars, as a Finger. The third admitteth those of the second Degree, as the Hand. The fourth is made of the Third and other Parts, as the Arm.

Parts, from their End, or Use, are distinguished into Principal, and less principal, or

ministring. The Principal are the Liver, Stomach, Heart, Brain. The ministring are either necessary, or not so. The necessary are those, without which the Animal cannot live. So the Lungs minister to the Heart, the Guts to the Stomach. The not necessary are simple Flesh, &c. For in consumptive Persons it is almost wholly spent; and Insects, according to *Aristotle*, have none at all.

Beside these Divisions of the Parts, there are others somewhat different, the Distribution being in great Measure arbitrary, suited to the Humour or Design of each Author, and the Share he takes in the Profession. Thus *Fernelius* divides the Body into publick and private Regions. The private are such as the Brain, the Reins, the Womb, &c. The Publick are three. The first hath the *Vena portæ* and all the Parts, to which its Branches extend. The second begins at the Roots of the Cava, and ends in the small Veins before they become capillary. The third hath the Muscles, Bones, and the Bulk of the Body, terminating with the Skin. But this Division is only of use in Physick.

Anatomists have a Method, which suits their Purpose and the Physicians too. They divide the Body by the Cavities appointed to receive the principal Parts, and such as minister to the same. These are three. The
Head

Head which is for the Brain, the Breast for the Heart, and the Belly for the Liver. And because this last Cavity is most subject to Putrefaction, they begin their Operations here.

I begin with it for another Reason, because being to treat of *Physiology*, it affords us a direct Admission to those Parts, which are the first Instruments of animal Oeconomy, and upon which, in its succeeding Stages, it principally depends. Three things then here offer themselves to our Consideration. First, the Circumscription, or Bounds of the *Abdomen*. Secondly, the Regions of it. Thirdly, its internal Parts: the two first of which have been before described, and therefore we proceed to examine the containing Parts of the Body, in order to penetrate the inner Parts.



C H A P. IX.

The anatomical Description of the PARTS which present themselves in opening a Way to the grand Organ of Chylification, the STOMACH, and first of the containing Parts, of the Belly, which affords an Occasion of speaking of the Skin in general, and other Coverings common to that, and all other Parts of the Body.

THE containing Parts of the Belly are either common, or proper. The common containing Parts are four; the Scarf skin, the Skin, the Fat, the fleshy Membrane, or *Membrana carnosæ*.

In common Speech the two Skins are comprehended under one Denomination. In *Latin*, the Skin of Man is expressed by the Word *Cutis*, that of Beasts by *Aluta*. The Greeks call the former δέσμα and δέρσις. Of all the Membranes of the Body it is the thickest, having upon Examination a double Substance. The one is external, called ἐπιδέρμις ὅτι ἐπὶ τοῦ δέσμα τίθεται, because it is placed as a Covering upon the Skin. It is termed *Cuticula* in *Latin*, and is as large as the Skin, and more compact. For sharp Humours passing thro' the Skin are stopped by the Thickness of the
Scarf-

Skarf-skin, and for Want of a Passage there, rise in Pustules between them both: In Man this Membrane somewhat resembles the Peeling of an Onion; and is without Blood, and without Feeling. Some imagine it to be formed by an oleous Vapour from the Blood, raised by the natural Heat of the under Parts, and dried and condensed by the external Cold; but Dr. *Glisson* not improbably takes it to be a soft, slippery, viscid and transparent Juice, something like the White of an Egg, that issuing out of the capillary Extremities of the Nerves, which end in the outer Superficies of the true Skin, is there coagulated, and by its Viscosity sticks upon it like Glue, so that it can hardly be separated from it by a Knife, though easily, in living Creatures, by a Vesicatory; and in dead Persons by Fire or scalding Water. Distempers sometimes produce the same Effect, we see it peel off, after burning Fevers, and the *Small-Pox*, though its Place is soon supplied, as a new one presently succeeds. It defends the *true Skin*, which is of exquisite Sense, from the too violent Pressure of outward Bodies. For when this is rubbed off, that cannot touch them but with Pain. In cold Weather it breaks the Action of the Cold, that Perspiration may not be altogether hindered; as in immoderately hot Weather it restrains, by its Compactness, too great a Perspiration: it keeps the ichorous Substance from issuing from the Arteries, which

which oozes out immediately when the *Cuticula* by any Accident is taken off; and beside these necessary Uses, it makes the Body beautiful, by smoothing the Roughnesses of the true Skin, and covering, with its agreeable Whiteness, the offensive Sight of the other's bloody red: though that indeed is naturally white like other Membranes; but in healthy Persons, and such as live in a moderately cold Climate, it acquires the Colour beforementioned. While in those who live under the Equinoctial Line, and excessively hot Climates, it appears black on the outer Superficies, because they having a softer Skin, and their Pores large and loose, many Vapours of the adust Humours are raised with the Sweat; the grosser Substance whereof being stopped by the Scarf-skin, and by reason of the excessive Heat, there dried and burnt, may possibly be the Reason of that peculiar Colour; for their Infants are not born black but reddish. The Pores of the Skin are generally most visible in white People, and in cold Countries. For if it be laid bare in Winter, the *Cuticula* appears covered all over with little Excreffences like a Goose's Skin. The true Skin is generally reckoned to be six Times thicker than the other, and is made up of nervous Fibres closely interwoven one with another, and of a Parenchyma, which fills up the Interstices and Inequalities thereof. That there is such a Parenchyma may be proved

proved by the Experiment upon a Sheep-skin, which when steeped in Water, and scraped by an Ivory-Knife, or such-like Instrument, affords a great deal of mucous slimy Matter, by the Loss of which it becomes much lighter and thinner, and in some measure transparent, as we see in Parchment.

The Skin of the Forehead and Sides is thin, it is thinner yet in the Palms of the Hands, but thinnest of all in the Lips and Scrotum. It is thickest in the Head, the Back, and under the Heel, where it is sometimes as deep in Substance as a Barley-Corn, and rather a *Callus*, than *Cuticula*; it takes that Appearance likewise in the Hands of laborious People, who are continually handling hard Instruments.

It is thinner in Children, and in Women, than in Men, and in those, that live in hot Countries, than in those that live in cold. For this Reason the Inhabitants of colder Climates coming under the Line, are so often taken with Fevers: because the great Heat, which is there excited in the Body by the outward Air, cannot exhale for the accustomed Thickness of the Skin.

The Skin hath an Action, to wit, the Sense of Feeling; it cloaths the outward Parts, and defends them from Injuries: and serves as a general Vent, or Emunctory to the Body. That the Reader may the better conceive how this is performed, it may be necessary to describe

scribe more particularly the several Appearances of the Skin, as they present themselves, when the Scarf-skin is removed. *Keil* observes first the *Papillæ Pyramidales* or Ends of the Nerves, and between these *Papillæ* an infinite Number of *Holes*, which are the Orifices of the *excretory Vessels* of the *miliary Glands* underneath; about these *Papillæ* is spread a mucous Substance, which because it is pierced by them is called the *Corpus reticulare*: these altogether compose the first Stratum. The second is a Web of *nervous Fibres*, and other *Vessels* differently interwoven, which form the *Parenchyma*, or that Part of the Skin, of which Parchment is made. Under these two Parts lie the *miliary Glands*, which as they are mixed with the Fat, are perhaps not so properly to be reckoned to the Skin; of their Office we shall speak in their Place, as we come a little to enlarge upon this *Division*. It is to be noted here, that upon the *Surface* of the Skin there are many parallel Lines, which are cut by as many parallel ones, these Intersections make Spaces of a rhomboidal Figure, and out of each Angle, for the greatest Part, grows an Hair, shorter or longer, as Nature requires, in the several Parts of the Body; but in the Palm of the Hand, where there are no Hairs, these Lines do not intersect one another, and on the Ends of the Fingers they are spiral. *Boerhaave* observes, that the *sudoriferous Vessels* are hid in the Middle of these

these Channels, and that the *Papillæ* of the Nerves occupy the Sides. “ *In medio horum*
“ *Sulcorum tuto condita hærent Vasa sudorifera,*
“ *in utroque autem Sulci latere parallela priori*
“ *series Papillarum nervearum.*”

To enlarge a little upon the foregoing Description. *Boerhaave* observes, that the Ends of the Nerves rising thro’ the Mucus aforementioned, leave there their outward Covering, which they receive from the *Dura mater*, and make thereby a Piece of Network, first discovered by *Malpighi* in the Feet, Hands, and Tongue ; afterwards the celebrated *Ruyfchius* improved upon the Discovery, and found the Appearance of *Papillæ* in all Parts of the Body, though somewhat different in Form, and more conspicuous, and frequent in the most sensible Parts. *Boerhaave* observes of this Piece of Net-Work, from whence they rise, that it has no serous or sanguiferous Vessels. There are however that pierce this Texture, subcutaneous *Arteries* in great Number, and subcutaneous *Veins* ; which latter receive and suck in any Moisture, that comes from without, mixing it first with a thinner *Lymph*, then with a thicker, and lastly with the *Blood* itself. The Truth of this is grounded upon many infallible EXPERIMENTS, “ *Li-*
“ *quores extrinsecus insinuatō accipiunt, ac Lym-*
“ *phæ tenuissimæ, aquosæ primo, dein hinc Lym-*
“ *phæ sensim crassiori, sero postea, tandem deni-*
“ *que ipsi sanguini miscent, ut multa, et certa*
“ *Experi-*

“*Experimenta docent*,” which ought to be a Caution to People, how they touch, or suffer their Hands to be licked by any infected Person or Thing; most especially if the Skin be razed, so as to let the least Particle of Blood appear. Under the Skin too, and upon the Fat there are, through the whole Compass of the Body, Glands, which are called *miliary*. They have each an Artery, Vein, and Nerve, and a discharging Vessel, going outward, which rising through an Hole in the reticular Covering, or Net-work aforementioned, affords a Passage for the *grosser* Sweat under the Epidermis. For Outlets of the *thinner* Sort, there are beside, under the Scales of the same Epidermis, other exhaling Vessels of such extraordinary Fineness and Subtilty, that according to *Lewenboeck’s* Computation, no less than 125,000 of them open themselves in the Space of a common Grain of Sand. This Relation however is incredible. For supposing it true, that so many Mouths should open themselves in so small a Compass, yet I hold it quite impossible, that any human Art should enable a Man to find Marks of Distinction, whereby to count the Number. Their Multiplicity, notwithstanding, must be surprizingly great: since by their Means, there happens perpetually in every the smallest Particle of the Body, a most subtle Perspiration, which is called from the Name of its first Observer *Sanctorius*, the *Sanctorian* Perspiration. This Va-
pour

pour arises not only all over the external *Epidermis*: but also from the Cuticle of the Mouth, Nostrils, Swallow, Wind-Pipe, Lungs, Gullet, Stomach, Intestines, Bladder, Womb; in such a Quantity as to exceed all the aggregate Substance of the other Excrements. Insomuch, that in the Air of *Italy*, in a Person of middle Age, easy Circumstances, and temperate Life, it was found, that five Eighths of what he took for Nourishment went off by the Mouth, the Nostrils, and the Pores of the outer Skin.

Cbeselden, after *Hales*, thinks, that they have found an Error, in *Sanctorius*, in ascribing so great a Discharge to *Perspiration*, when, as they think, *Respiration* takes off more; but the Passage of *Boerhaave* above cited, concerning internal Perspiration, vindicates this great Author, and shews, that the Matter, which goes off with the Breath, is nothing else, but the collected *internal* PERSPIRATIONS of that Channel.

When this Sort of Perspiration is most subtle, most equable, and in the greatest Quantity, it is a Demonstration of a most perfect state of Health, and the most effectual Instrument of its Preservation: as on the other hand, its Absence gives the first Notice, and is perhaps the first Cause of approaching Sickness.

After the Removal of the two Skins, in the next Place there appears the Fat, which is commonly taken to be distinct from the

Membrana

Membrana carnosa, which lies under it, but is indeed only a Part of the same. For that on its outer Side it abounds with membranous Cells, which are filled with a yellowish Fat.

But however, having noted this Error, we shall speak after the Manner of former Anatomists, and consider it as something separate, and so define it to be an *oleous Humour of the Body, elevated by the moderate Heat of the Parts lying under it, and concreted between the car-nous Membrane and the Skin in membranous Cells*. Now though in Men, this Fat lies immediately next to the Skin, yet in Beasts the *Membrana carnosa* comes between them, and is indeed muscular, and so closely joined to the Skin, that they can many of them move the Skin with great Violence; an Horse cannot only drive off Flies, or any little Insect that offends him, but even sometimes by this Sort of Motion shake his Rider. But it is not so ordered in Men, in any Part of their Bodies, except their Forehead, which they can move in the same Manner.

But to return, this membranous Fat is properly distinguished by the *Latin Word Pinguedo*, whereas that of the Caul is termed *Sevum*, that is Suet, or Tallow. And they differ in this, that *Pinguedo* is easily melted, but not so easily congealed: whereas *Sevum* is not so easily melted, but easily congealed; beside the former is not brittle, and the other is.

The

This Fat defends the Body from the Air, preserves the natural Heat, fills up the Wrinkles of the Skin, and the Cavities of the Muscles, lubricates the Vessels, the Extremities of the Cartilages, and the Joints of the greater Bones, and in an especial Manner helps the Concoction of the Stomach.

The next common Covering is the *Membrana Carnosa*, or *ὀμὴν σαρκώδες*, so called in Man, not that it is in him fleshy (but nervous, and so should rather be called *nervea*) but because in Beasts, which the Ancients used most commonly to dissect, it is endued with fleshy Fibres. In the Birth it is red, but white in those, who are of Age, and more fleshy in the Forehead and Neck, than in any other Part. It is bedewed within by a viscous Humour, to further the Motion of the Muscles, and keep the Superficies of them from Desiccation, which otherwise might happen from their frequent Motion. This Membrane is of exquisite Sense, wherefore, when it is pricked with sharp Humours, it causes Shiverings, such as are felt in the beginning of Ague-fits. From which Physicians would do well to distinguish them, even tho' they should be periodical. For that may be occasioned by such common Causes as Meat and Drink; which if taken at stated Times, will at stated Times, by inflaming the Humours, produce the same Symptoms.

C H A P. X.

Introduction to an Account of the Muscular Coverings of the Belly.

THE *proper Containing* Parts of the Belly are the *Muscles*, and the *Peritonæum*. But before I say any thing of these Muscles in *particular*, it may be necessary to speak first of a Muscle in *general*, and its constituent Parts, as such a Description will extend the Reader's View a little farther into the Constitution and general Fabrick of the human Body: and contribute to the clearer Understanding of some Things, which in the Course of this *Compendium*, may chance to be advanced upon other Subjects. A Muscle, in *Greek*, is called $\mu\upsilon\varsigma$, of which *Musculus* in *Latin* seems to be a Diminutive; as if it resembled a flea'd Mouse; or else from $\mu\iota\upsilon\varsigma$, to contract. " It is a *dissimilar*, or *organical* Part (framed
 " of its proper Membrane, a fibrous Flesh,
 " a Tendon, Veins, Arteries, and Nerves)
 " appointed by Nature to be the Instrument
 " of free Motion." The Parts are either common or proper. The common are three: the *Vein*, the *Artery*, and *Nerve*. The proper as many. The *fibrous Flesh*, the *Membrane*, and the *Tendon*.

The *Arteries* bestow on the Muscles (as on all other Parts of the Body) the vital Heat
 and

and Nourishment; the Veins carry back from them what Blood is not assimilated to them, and the Nerves bring the animal SPIRIT, whereby their Action is performed. These Nerves spring either from the *Medulla oblongata* within the Brain, or from the *Spinalis*, so called after it has descended from the Skull to the Spine. The Nerve is inserted either into one End, or about the Middle of the Muscle; but at what Part soever it enters, that is reputed the Head or Beginning of the Muscle. As soon as it has insinuated itself into the Muscle, it is dispersed into a Number of Twigs, which end in it, being continued or prolonged into Fibres.

A *Fibre* is variously described, according to the various Designs of different Authors, or the Variety of its Place, Use, or Figure. *Haller's* Account respects its Form, and the Matter of its Composition. A *Fibre*, says he, in general resembles a Line of moderate Breadth, or rather a thin Cylinder. Its most durable Parts are earthy, as is evident when it has undergone the Fire, or long Putrefaction. The Cohesion of these Particles of Earth, when formed into a Thread, is not from themselves, but from a Glue, that surrounds, and sticks between them. This Glue is compounded of Oil and Water, as appears by the Chymical *Analysis* of Bones, Hairs, Ivory, &c.

The Definition of our Countryman, the

Dr. *Gliffon*, has some Respect to the Matter and Composition, but more to the Form, and Properties of a Fibre. In his chapter *de Ventric.* he defines it to be “ a Body in Figure like a Thread, slender, tenacious, “ tenfile, and irritable, made of spermatical “ Matter, for the sake of exerting some Motion or Strength.”

This Definition he amplifies and explains in the following Manner. [In figure like a Thread] *i. e.* oblong and round; [slender] like a Spider's Web; [tenacious] whose Parts firmly cohere, and are not easily to be broken; [tenfile] that may be extended as to Longitude, its Latitude being lessened, and in like Manner thickened in Latitude, its Longitude being shortened; [irritable] *i. e.* which by Irritation may contract itself, and the Irritation ceasing be remitted of its own accord; [made of spermatick Matter] for the Fibres covered, may be divided into sanguineous and spermatick: of the former Kind are those of the Muscles; of the latter, those of the Stomach, and Guts; [for the Sake of Motion and Strength] because, in that it is tenacious, it adds Strength to the Part, as by its Aptness for Extension, and Contraction, it is instrumental to Motion. These Fibres being stopt in their Interstices with a sanguineous Parenchyma, make that Substance, which we properly call Flesh, without Fat. For all the Flesh of a Muscle seems to be nothing else,

else, but that Portion of the Blood, which flowing into its Intervals, is thickened by their Coldness, or by Assimilation fixed and retained among them.

As there is hardly any Part of the human Body but what is *fibrous*, Physicians are apt to judge of the State of the whole System, by the State of the Fibres. *Baglivi* has written a Treatise, *de Fibra Motrice & Morbosa*. And *Boerhaave*, in his *Aphorisms*, that is, Determinations of Cases, which occur in the Practice of Physick, gives the Reader a Detail of the rigid and lax Fibre, as a Lesson of prime Use, for the Understanding all other Distempers.

The *Fibres* are commonly streight, sometimes indeed they have other Directions: but the Muscles of the Belly, called oblique and transverse, have not their denomination from the form of their Fibres, (for they are all streight) but from their own Position, and Situation. Thus the Muscle called *Masseter*, is accounted double, because it hath two Sorts or Ranks of Fibres, lying one upon another.

Every Muscle has a proper Membrane, that invests it, and distinguishes it from others. In such Muscles as have a *Tendon*, it is continued to the Tendon.

The *Tendon* is the last proper Part of a Muscle. It is a *similiar* Body of a finewy Substance, and yet it has a particular Substance differing from a Sinew; it is white, but with a peculiar Brightness, dense, hard and smooth,

extended according to the Length of the Muscle. Its Beginning may be reckoned to be at the Head of the Muscle, whence passing through the Belly of it, it ends in the Tail.

All Muscles appointed for the Moving of Bones, have Tendons inserted into them; but commonly those, which move the other Parts, as the Tongue, Lips, &c. as also the *Sphincter* of the Bladder, and *Anus*, have none, at least none that are easily discoverable, though some affirm, that every Muscle has its Tendon.

A *Tendon* is not framed, as many have imagined, of the *Nerve* and *Ligament* mingled together: first, because a Nerve being lax and soft, will not admit of a Mixture with the Ligaments, which are hard. Secondly, because the Nerve is not carried in the Form of a Nerve to the Tendon, but is either continued to, or makes the Fibres of the Muscle. Thirdly, Ligaments are insensible; but Tendons are of exquisite Sense; as appears by the great Pain, which ensues on pricking them. A Tendon therefore either is framed by Nature, out of the first Matter of the Embryo, as other Parts, which are called spermatick are, and so is an independent Part: or else it is a Coalition of the Fibres of the Muscles, emptied or freed from their *Parenchyma*.

As for the Figure of the Tendons, they are sometimes round, as in the *musculus Biceps*: sometimes broad, as in the oblique and transverse

verse Muscles of the Belly. These are the constituent Parts of a Muscle; as for the external Figure, it is divided into three, the Head, the Belly, and the Tail. The Head is the Beginning, or that Part towards which the Muscle is contracted; the Belly is the thickest Part, and most Flethy; the tail is the End inserted into the Part, to which it is to give a Motion, and is called in *Greek* ἀπὸνέυρωσις, and commonly *Tendo*.

The Differences of the Muscles are taken first from their *Substance*: so some are fleshy, as those of the Tongue and Larynx; some membranous, as the *Constrictores*, or internal Adducts of the Nose; some are partly fleshy, and partly nervous, as the temporal. 2dly, From the *Quantity*, some are long; as the straight Muscle of the Abdomen, the longest of the Back, &c. others short, as the Pyramidal at the Bottom of the Abdomen; some broad, others narrow; some thick, others thin and slender. 3dly, From their *Situation*: from whence some are called *external*, some *internal*; some *oblique*, some *straight*, some transverse. 4thly, From their *Figure*, as *Deltoides*, from its resemblance of the *Greek* Letter *delta*. 5thly, From their Beginning, as some proceed from Bones, one or more; some from Cartilages or Gristles, as those of the Larynx. 6thly, From the *Variety of their Parts*, as *Bicipites* and *Tricipites*, from their having two or three Heads, *Biventres*, &c. 7thly,

From *their Composition*: some are single, some double, &c. The *unity* of the Belly and Membrane, that incloses the Muscle, causes the *Unity* of the Muscle; as contrariwise the *Plurality* of these, its *Plurality*. 8thly, From their *Action*: some are from hence called *Fraterni*, or *Congeneres*, Brothers; some *Antagonistæ*, or Adversaries; some only move themselves, some the Parts adjoining; some have one Action only, others divers, as the *Masse-ter* and *Trapezius*. Lastly, there arises another Difference from the Variety of the Action: hence *flexores*, *extensores*, *elevatores*, *depressores*, *adductores*, *abductores*, *suspensores*, *rotatores*.

As for the *proper Action* of a Muscle, it is nothing else but the Contraction of it towards its Beginning. The Variety of the Action proceedeth from the Variety in the Form and Situation of the Muscle. The Differences are, 1st, the Contraction; 2dly, the Perseverance of the Contraction; 3dly, the Relaxation of the Contraction; 4thly, the Perseverance of the Relaxation. This Perseverance is called *Motus Tonicus*, the Member being still kept in the same Posture.

To sum up then this general Account of the Muscles, according to the ancient Notion, which some Moderns have contradicted, but not refuted, the efficient Cause of their Action is the Soul moved by its own Appetite or Inclination. It uses three Instruments, the
Brain,

Brain, the Nerve, the Muscle. The Brain in a surprizing and incomprehensible Manner receives the Charge; the Nerve, by the Ministration of the animal Spirits, carries it to the Muscle; and the Muscle performs the Action, which in an healthy State may be defined “a voluntary Contraction of itself towards that Quarter where it begins, for the Sake of moving that Part into which it is inserted.” Of this Sort of Instruments or Organs, upon opening the Belly, there appear to the Diffector, first, the oblique descending Pair; secondly, the oblique ascending; thirdly, the *Recti*; fourthly, the pyramidal; and lastly, the transverse. A more particular Account of these, and the other Covering, called the *Peritonæum*, the Reader will find in the next Chapter.

C H A P XI.

Gives a Description of the containing Parts of the Belly, the Muscles, and the Peritonæum.

THE *Abdomen* or lower Belly hath ten Muscles, *five* on each Side.

The first Pair, *par obliquè descendens*, or the oblique descending, are parted into seven or eight fleshy Portions, like Comb-Teeth, and intermixed with the *serratus major* of the Breast, which being divided in like manner, imitates a Saw, and from thence derives its Name.

The Pair, just mentioned, spring from the lower side of the sixth, seventh, eighth, ninth, tenth and eleventh Ribs, and the transverse Processes of the *Vertebræ* of the Loins, adhering also to the Edge of the *Os ilium*, from all which Places the Fibres descend obliquely, till the Muscles from each Side end in a broad Tendon, in the *Linea alba* in the Midst of the Belly, which Tendon cleaves so fast to the *oblique ascending*, which lie under these, that they cannot be separated without tearing. The *Linea alba*, in which these Tendons end, is a white Line running from the *Mucronata Cartilago*, at the Pit of the Stomach down to the Middle of the Belly, by the Navel, to the

Ossa

Ossa pubis, and is made of the Concourse of the Tendons of the Muscles of the Abdomen; namely, of this Pair already mentioned, and the *obliquè ascendens*, the *transverse*, and the *pyramidal*.

The *second Pair* is called *obliquè ascendens*. These lie next under the former, and their Fibres ascending obliquely cross those of the other, like an X; they rise from the Spines of the *Os sacrum*, with a membranous Beginning, and from the Edge of the *Os ilium* with a fleshy. Ascending carnos from hence they are joined to the Cartilages of the eighth, ninth, tenth and eleventh Ribs, and end in the *Linea alba*, with a broad and nervous Tendon.

The *third Pair* is the *Rectum*, or Streight. These arise fleshy from the lower Part of the *Sternum*, from both Sides of the *Mucronata Cartilago*, and from the cartilaginous Ending of four Ribs, and so marching down streight along the Belly, they are inserted by a strong Tendon into the *Ossa pubis*. Each has sometimes three, sometimes four transverse Inscriptions, or Intersections, that appear tendinous, whence some divide them into four or five Muscles, according as they have three or four Intersections. And indeed, if *Galen's* Rule be true, that wheresoever the Nerve is inserted into the Muscle, there is its Head; we must confess, that they are distinct Muscles. For Nerves are inserted both into their upper
and

and lower Parts, and into each of those, that lie between the Intersections. And by supposing them thus distinct, we may conceive how they may better perform their primary Action, which is strongly to compress the Belly for the Expulsion of the *Fæces*, or *Fætus*. Under these Muscles the *Arteriæ*, and *Venæ mammariæ* descend to about the Navel, as the *Arteriæ* and *Venæ epigastricæ* ascend to near the same Place, and these were held to inosculate one with another (the descending with the ascending) till of late ; but now that Inosculatation is discovered to be only imaginary.

The *fourth Pair* is the *Pyramidal*. These are placed above the lower Part of the *Musculi recti*. They arise from the *Ossa pubis*, small, and carnous, where they receive their Nerves. They are broader at their Basis, and grow narrower as they ascend, whence they have their Name of pyramidal. They climb up upon the *Recti*, about four Fingers breadth (the left being the shorter and the narrower) and insert their acute Tendon into the *Linea alba*. They are said to assist the *Recti* in their Action, and are therefore called *succenturiati*. But they seem more particularly to serve to compress the Bladder in making Water. Sometimes one, sometimes both of these are wanting, and then the *Recti* are broader, and more carnous.

The *fifth Pair* is the *Transverse*; which are firmly knit to the *Peritonæum*, and whose Fibres

bres run cross or athwart the Belly. They spring from a Ligament, that grows from the transverse Processes of the *Vertebræ* of the Loins, from the *Os ilium*, and the cartilaginous Ends of the lower Ribs, having the same Arteries, Veins, and Nerves, with the obliquely ascending, and end in a broad membranous Tendon in the *Linea alba*.

The Use of all these Muscles hath been held to be, first, while the Body is at rest, to strengthen the Parts adjacent, and to encrease their Heat: and secondly, when they are in Action, to further Excretion, and the Expulsion of Excrements; to help the Delivery of the Infant, to assist the Breast in strong Expiration, Expectoration, Vomiting, to bend the Spine in the Act of Stooping, &c. *Diemerbroeck* thinks, that the streight, pyramidal, and transverse serve for the Compression of the Belly, and that the oblique elevate or dilate it. For at the Time of Inspiration, the Abdomen is elevated as well as the *Thorax*. Moreover an alternate Elevation and Depression seem necessary for furthering the Motion of the Aliments and Humours, thro' the Parts contained in the lower Belly.

The Muscles being removed, we come to the *Peritonæum*, or inmost Coat of the Belly. It has its Name from its Office of encompassing, ἀπὸ τοῦ περιτείνεσθαι. It is tied above to the Midriff; below to the Share and Flank-Bones; in the Fore-Part firmly to the transverse

transverse Muscles, but chiefly to their Tendons, about the *Linea alba*; behind to the fleshy Heads of these Muscles loosely. The End of this firm Connection is to press equally the Belly, for the Expulsion of the Ordure, and for Respiration. Without this Connection with the Muscles, the *Peritonæum* had been wrinkled, the Muscles being contracted; as again, had it not been loose tied to the fleshy Parts, the Contraction of them in the Compression of the Belly had been hindered.

Its Figure is oval, its Substance a Membrane, its inner Superficies next the Guts smooth, equal and slippery, bedewed with a kind of watery Humour, contained in the Abdomen: but the outer Superficies, whereby it cleaves to the Muscles of the lower Belly, is rough and unequal.

As for the Origin; *Fallopian* will have it to proceed from that strong *Plexus* of Nerves, from whence the *Mesenterium* is said to have its Beginning. It is double every where, but appears to be so chiefly about the *Vertebræ* of the Loins, where, between the Duplications lie the *Vena cava*, the *Aorta*, and the Kidneys. In the *Hypogastrium*, two Tunics are also apparently seen, between which are the Bladder and the Matrix. The umbilical Vessels also are placed in the Duplication of the *Peritonæum*. Above, where it is tied to the Midriff, it has three *Foramina*, or Holes: the first

first on the right Side, whereby the ascending Trunk of the *Vena cava* passes; the second on the Left Side, for the Gullet, with the Nerves inserted into the Mouth of the Stomach; the third, by which the great Artery, and the Nerve of the sixth Pair may pass. Below it has Passages for the strait Gut, for the Neck of the Bladder, and in Women for the Neck of the Womb; also for the Veins, Arteries and Nerves, that pass down to the Thighs. Before, in the Fœtus, for the umbilical Vessels and *Urachus*. But the most remarkable Processes are two on each Side of the *Os pubis*, which are oblong Productions of its outer Membrane, passing through the Holes of the Tendons of the oblique and transverse Muscles, and depending into the *Scrotum*, there bestowing one Tunicle upon the *Testes*. There are also two Processes in Women, but they reach only to the *Inguina*, and terminate on the upper Part of the Privy. The inner Membrane of the *Peritonæum* in Men, reaches no farther than the Holes, which it makes very strait, but being either relaxed or broken, the outer Membrane gives way, and so there follows a Rupture; either the Caul, or the Guts, or both falling down together. By the Holes of the Processes in Men descend the *Vasa præparantia*, and the *cremaster* Muscles, as by the same Passage there ascend the *Vasa deferentia*. In Women there
pass

pass by them the round Ligaments of the Womb, &c.

The *Peritonæum* is thickest below the Navel, to support the Intestines, which bear down heavy on that Part, in the Posture of sitting or standing. In Women with Child, it is also very much extended in that Region. And thus much of the Parts containing.



C H A P. XII.

Of the Omentum, or Parts contained, otherwise called the internal Parts of the Belly.

THE Parts *contained* serve either for *Nutrition*, or *Procreation*. As for the Parts serving for Nutrition, they either contribute to CHYLIFICATION or SANGUIFICATION. The principal Cause of CHYLIFICATION is the Stomach, but the Adjuvants are the *Caul*, and the *Pancreas*, and not only those, but one may add, every Organ or Vessel great or small, that administers Addition or Alteration to the Chyle, in its Passage to the *Receptaculum Chyli*, and *ductus Thoracicus*. For it is reputed Chyle till it mixes with the Blood. But if it be not so reputed, then the Liver and the Spleen, as antiently, may be reckoned Instruments of Sanguification; if the Spleen minister to the Liver, and the Liver give the last Alteration to

to the Chyle, before it enters the *Receptacle* and *Duct*. Upon this Head, the Opinions of the Antients and Moderns agree in some Particulars; and the Concessions of the latter are such as shew, that the Judgment of the former is not to be so much exploded.

Hippocrates calls the Spleen the Left Liver, *Aristotle* the Left, or Bastard Liver. *Boerhaave* (*Med. Instit.* Page 174.) subscribes, and says, "*Patet usum splenis inservire Hepati.*" &c. Nay, he makes the Liver still an Organ of greater Consideration by the Ministrations or Subserviency of other principal Parts, affirming that "*omnia viscera abdominalia*" "*χυλοποιήσι inservientia, splenem, omentum, ventriculum, pancreas, mesenterium, intestina,*" "*uni jecori inservire, inferendo venosum, sed*" "*mire mutatum sanguinem.*" Well then again, out of this Liver, the same Moderns tell us, that there issue lymphatick Vessels, which open themselves into the *Receptaculum Chyli*. "*Vasa isthæc ex hepate prodeuntia, venamque*" "*portæ comitata, pancreatis partem perreptant:*" "*quam primum autem illa bifurcatur, ramo*" "*mesenterico associantur; pauloque post, facto*" "*diverticulo, versus receptaculam commune abe-*" "*unt, inque ipsum exonerantur: ubi liquor eo-*" "*rum chylo commiscetur, et cum hoc unâ in*" "*venam subclaviam transfertur, &c.*" (*Glisson. Anatomia Hepatis sub finem.*)

What is this Lymph, and what its Properties, which is carried from the Liver directly

to the *Receptaculum Chyli*? Why may it not contain the Matter for preparing the Serum of the new Blood, as the Chyle contains the Matter for making the Curd of it? It gives at least, by their own Account, the last Alteration to the Chyle, and why is not this the first Stage of Sanguification? But I have not Room for a long Controversy. So putting in a Word to countenance the Antients, to whom we owe the Foundation of all Knowledge, and consequently of our own Discoveries, and who, as in other Sciences, so in this, had much more Penetration, than what our conceited Moderns, from their Ignorance of their Writings, are willing to allow them, I resume the Subject. The whole Chyle so prepared, as before-mentioned, is conveyed on by the *Ductus Thoracicus* towards the Heart, and so into the Mass of Blood. The Excrements of the *Chylification* are received by the Guts. The Excrements of *Sanguification*, supposed to be two, the Choler and the serous Humour, are disposed of in another Manner. The thin Choler, according to some, is received by the *Vesica fellea*; the thicker by the *Meatus cholidochus* (*Boerhaave* says quite the contrary, *Est* (I.) *vesicæ bilis spissior*, &c. so little is there of Science in the Art of Physick!) The serous Humour is turned to the Kidneys, and from thence by the Ureters, to the Bladder. The Parts appointed for *Procreation*

tion are the Genitals, both in Men and Women. But to return to the Parts we were describing.

Next then to the *Peritonæum* is the *Omentum* or *Caul*, in Greek it is called ἐπίπλοον from ἐπιπλέειν. Because it seems to swim upon the Intestines, the *Arabians* call it *Zirbus*. It is composed of two Membranes, and of Vessels, Glands, and Fat. The uppermost Membrane springs from the Bottom of the Stomach, and is tied to the hollow Part of the Liver, and to the Spleen. The inner or lowermost arises from the *Peritonæum* immediately under the Midriff toward the Back, and is tied to that Part of the Gut Colon, which passes under the Stomach Lengthways to the *Pancreas*, or Sweet-bread, and also to the Midriff, and to the *Intestinum duodenum*.

It's lower Part hangs loose, and reaches in most People below the Navel; but in some, that are fat, to the very *Os pubis*. Its Bottom is closed in Resemblance of a Pouch: and from its double Origin there arises betwixt its Partitions a notable Cavity. It abounds with Vessels. Its Arteries are propagated from the *Cæliaca*; or rather the inner Leaf of this Membrane near its Origin, receives and upholds this Artery, as soon as it passes out of the *Aorta*, betwixt its Membranes. It is divided into two Branches, the right and left; the right being joined to the *Vena portæ* in the *Pancreas*, and fenced with the Membranes of the *Omentum*, is carried into the

Cava of the Liver: but it first sends forth these Branches, the *Pyloricus*, to the hinder Side of the right Orifice of the Stomach; the *Arteriæ cysticæ gemellæ*, the *Epiplois dextra*, dispensed to the Colon; the *Intestinalis* to the *Duodenum*; the *Gastro epiplois dextra*, which is distributed into the right Bottom of the Stomach. The left Branch of the *Cœliaca* called *Splenicus*, is greater than the right, and being included within the Membranes of the hinder Leaf of the *Omentum*, is carried directly left-ways to the Suture of the Spleen under the Bottom of the Stomach.

In its Passage it sends forth many Branches; upwards, a remarkable one called *Arteria gastrica*, which washes the Bottom and Sides of the Stomach, and its upper Orifice, and there gets the Name of *Coronaria*; also a second, called *Gastro epiplois sinistra*, whereof one Portion is dispersed into the Bottom of the left Part of the Stomach, and both its fore and hinder Parts, and the Remainder is spent on the Fore-Leaf of the *Omentum*. As a third Branch it sends forth the noted *Vas breve Arteriosum*, which is inserted into the left Part of the left Orifice of the Stomach.

Downwards likewise it dispenses some Branches, as the *Epiplois sinistra*, which being divided into two Rivulets, waters partly the hinder Leaf of the *Omentum*, and partly the *Colon* itself; there is also another Branch, which is wholly spent on the left Part of the hinder Leaf of the Caul. The

The Veins, which answer to the said Arteries, rise for the greater Part from the splenick Branch, the Trunk of which Veins, after it is joined with the Stem of the splenick Artery, puts forth Branches exactly correspondent and proportioned to those of the same Artery, and all the Branches of both Vessels, are dispensed to the same respective Parts, and denominated from them: only the Branch, which goes to the right Orifice of the Ventricle, called of some *Pyloricus*, takes its Rise from the Trunk of the *Porta*, before it is divided.

It has but very small Nerves proceeding from a double Branch of the sixth Pair; and these, as the Veins, accompany the Arteries, and take the same Names.

Beside Vessels formerly known there are some who think, that they have discovered another Sort, called *Adiposa*, among which *Malpighius* is a leading Man: but my Author, Dr. *Gibson*, leaves it to the Curious to enquire farther; and denies that he could ever discover any such, either with the naked Eye, or such Glasses, as he made Use of.

Dr. *Wharton*, in his Book *De Glandulis*, cap. xii. declares, that he has observed some *Venæ Lactææ* to arise from the Bottom of the Stomach, and to be received into the *Omentum*, which being inserted into a pretty large Gland, from thence spring forth again, and are carried obliquely downwards, crossing the right Extremity of the *Pancreas*: they seem, at

first Sight, to enter the *Pancreas*, but they really pass by it, and make toward the common Receptacle of the Chyle, where they unload themselves.

The same learned Physician, gives an Account of two Glands naturally found in it; one greater, where it is joined to the *Pylorus*, and into which the *Lactææ* are inserted; the other less, which has its place towards the Spleen, which he has observed to be sometimes double, triple, or rather manifold. Preternaturally the Glands of the *Omentum* may still be more in Number.

The Fat of this Covering is placed about the Veins and Arteries, to strengthen them, and keep them from being compressed by the Completion of the Belly, or any violent Motions. When the Stomach is full, and the Guts empty, the upper Membrane of the Caul is raised, the lower remaining in its own place; but if the Guts be full, and the Stomach empty; then the lower Membrane rises, the upper remaining in its Place. *Spigelius* observes, that the lower end of the *Omentum* is left free and untied, to serve these different calls of nature. Its uses are generally reckoned to be, first the cherishing the internal Heat of the lower Part of the Stomach, and the Intestines. To minister Nourishment to the Parts in time of Famine. To convey (like the Mesentery) the Vessels safely, to other Parts, as to the Stomach, *Colon*, and
Duodenum,

Duodenum, &c. To keep the outer Superficies of the Guts moist and glib, that they may the better perform their peristaltick Motion. It has been observed by *Galen*, Lib. iv. *De Usu Partium* 9, that those, who have had a Portion of it cut off, by Reason of a Wound received in the Abdomen, have been forced to cover the Belly well, to make up the Deficiency, and have afterwards had a weak Concoction. Which Relation seems to be confirmed by the account of *Boerhaave* (*Instit. Med. P.* 177.) “ *Credibile simul apparet. aper-*
“ *turis Vasculorum minimorum, quæ innumera-*
“ *bilia per Omentum distributa, &c. exhalationi*
“ *Transudationi, & Resorptioni aptissima, to-*
“ *tius Omenti se insinuare tenuissimum Vaporem,*
“ *qui assurgit assiduo in Calido ventre, a subtili*
“ *rore huc Instillato per Oscula tenuissima Vaso-*
“ *rum exhalantium: quo deprehenduntur semper*
“ *telescere et humectari Species omnium Corpo-*
“ *rum intra Peritonæum hærentium, &c.*”



C H A P. XIII.

Of the Oesophagus, or Gullet; and the Salivary Glands.

THE *Omentum*, or *Caul*, being described in the former Chapter, and having now in View the Intestines and the Stomach, it

may be proper to give a short Account of the *primæ Viæ*, or first Passages: not only, as they are first in Place, in the Explication of Physiology, or animal Oeconomy, which is professedly my present Subject; but also because, when that Oeconomy is disordered, their Powers and Faculties are chiefly to be attended to, for the better Understanding the Operation of Medicines, a Science full as necessary to the Physician as the Knowledge of Nature, in its regular Course, when in producing the Chyle, it is laying the first Foundation, or forming the first Matter for animal Support. For the Medicines, as well as the Aliments, are conveyed into the human Body in the very same Manner, and are to be carried through the same Passages, if they are to produce their proper Effect.

To execute this at large, would be to exhibit more of the *Materia Medica*, and of the Anatomy of the human Body, than can be expected in a Compendium compiled only for the Help of my own Memory, or for the succinct and short Information of those, who though up to the Elbows in Practice, yet for the Theory of Medicine, the Lanthorn to the Practitioner, are rather more at a Loss than myself: I shall therefore only attempt at present briefly to describe those Parts, where both Aliments and Medicines undergo their first Changes, and perform their first Operations; such

such as the *Oesophagus*, the *Ventricle*, the *Intestines*, and the *Appendages* of the same.

The *Funnel*, or Continuation of the left Orifice of the Stomach, which extends itself upwards to the *Fauces* or Throat, is called in *English* the *Gullet*, from the *Latin*, *Gula*; in *Greek* it has the Name of *Pharynx*; and *Oesophagus*, ὅτι αἶε το φάγνμα, because it carries down the Meat. If you trace it from the Place of Carriage, beginning from the Root of the Tongue; it passes from thence directly downward, between the Windpipe, the *Vertebrae* of the Neck, and the four first *Vertebrae* of the *Thorax*; upon the which it rests; but when it is come to the fifth *Vertebra*, it gives Way to the Trunk of the great Artery, descending by turning a little to the right Side: afterwards accompanying the Artery to the ninth *Vertebra*, there it turns a little to the left again, and is raised up by Means of the Membranes, from the *Vertebra*, and marching above the Artery, it passes through the nervous body of the Midriff, at an Hole distinct from that of the great Artery, and is inserted into the left Orifice of the Ventricle, about the eleventh *Vertebra* of the Breast.

Upon opening this Channel, it appears by common Observation, to have three Coats, the inner of which however, is invested with a very fine Shag or Down, while the rest of it's Substance seems to be entirely nervous, composed of Fibres of various kinds, like the inner Coat

Coat of the Intestines, and the Stomach. Moreover, this Membrane is continued to that, which covers the Palate, the Mouth, the Jaws, and Lips; and also descending to the Stomach, not only covers it's Orifice, but extends itself three Fingers Breadth within the Sides of the same. This Extremity of the nervous Coat, when it comes within the Orifice of the Stomach, appears much more coarse and shaggy, and different from the inner Coat of the Stomach, from which it is easily distinguished after a little boiling. For upon this Operation, the Tunick from the Gullet grows extremely white. This is a Part of exquisite Sensation, and preserves for a longer Time the Flavour, whether agreeable or disagreeable, of the Things which we swallow, or even conceit the Taste of. So that an Irritation beginning here, Sickness and Vomiting will soon succeed. Moreover, by the deep Insertion of this Tunick into the Stomach, there is a quicker Communication between it and the Gullet, so that if either Part be inclined to vomiting, the other presently sympathizes with it: which Affection is, by the same Organ, immediately communicated to the Palate, Mouth, and Jaws:

The next Coat of the Gullet is so thick and fleshy, that it resembles a perforated Muscle: *Hofman* asserts, that it is really a Muscle, and subject to Palsies and Convulsions; and that famous Anatomist, and very learned Physician

Dr.

Dr. *Willis*, from whose *Primarum viarum Descriptio*, I take the greatest Part of this Chapter, of his own Knowledge, declares the same, “ *Novi quosdam ob Paralyfin in hâc*
“ *Oesophagi tunicâ carneâ excitatam, Deglu-*
“ *titionis magnâ Difficultate Laborasse, ali-*
“ *osque, ob Fibras penitus Resolutas, fame*
“ *interiisse.*” The Fibres of this Tunicle were generally thought to be round, and in a transverse Position; but *Stenon* observed them to be spiral, resembling the Figure in the Pedestal of a Wine-Glass, or the Worms of a double Screw. The same Dr. *Willis* says, that if this Coat be properly prepared, laid open lengthways, and then expanded, it will exhibit two Parallelograms on one side, and as many opposite, on the other. As this Coat consists thus of a double Row of Fibres, which obliquely ascend and descend, and mutually cross each other; it may be considered as a double Muscle: and as the descending serve to Deglutition and Swallowing; it is reasonable to think, that the ascending serve the Purpose of Spitting and Vomiting.

The third and outermost Coat of the *Oesophagus*, which is common to it and the Stomach, and arises from the *Diaphragm*, to which it is united in its passage, is the thinnest of any; its fibres resemble those of a Membrane, and are very fine withal.

My Author has many curious Remarks upon the Uses of the interior Coat of the Stomach, beside

beside that of receiving the Impressions of Objects, which affect the Taste, and conveying them, or rather the Ideas of them to (τῷ πρώτῳ αἰσθητηρίῳ, or) the prime Seat of Sense. As to the second Coat; it serves principally to Motion,--and the third seems to be only a common Tegument to the rest.

At the Insertion of the Gullet above, begin the Muscles serving to Deglutition: of those immediately connected, the first Pair, according to some, are called *Cephalopharingæum*, the second *Sphenopharingæum*, the third *Stylopharingæum*: below these is the *Sphincter* of the Throat.

The Gullet hath likewise four *Glandules*, two in the Throat, which are called *Tonsillæ*, or Almonds, common to the Gullet and the *Larynx*, which prepare and separate the pituitous Humour to moisten them both. There are two more about the Middle of it towards the Back, near the fifth *Vertebra* of the *Thorax*, where it gives Way to the Trunk of the *Aorta*, and turns somewhat to the right Side, or at that Place where the *Aspera Arteria* is divided into two Branches.

The *Veins* accompanying the Gullet arise in the Neck from the *jugular*; in the *Thorax*, from the *Vena sine pari*: but where it is joined to the Ventricle, it has some Twigs, from the *ramus Coronarius*, which proceeds from the *Porta*.

Its Arteries in the Neck arise from the *Carotides*;

rotides; in the *Thorax*, from the *Intercostals*; and in the *Abdomen*, from the *Ramus Cæliacus Coronarius*. The most apparent Use of the Gullet is to carry Meat and Drink to the Stomach; which it receives by dilating it's proper internal Coat, and turns them down by the Constriction of the middle Coat, and the Muscles of the *Pharynx*.

This Action, though curious, is not so generally necessary to be known in every Circumstance, as the Action of the Parts, which more immediately produce the Humours of the Body, which always make one essential Branch of *Physiology*; and therefore those, who are desirous to see what is said more particularly on the Muscles concerned in Deglutition, and their Office, may consult *Keil's Anatomy*, *Boerhaave's Medical Institutions*, from p. 27. to 51, and likewise the *Physiology* of his celebrated Disciple *Haller*, chap. 22 and 23: as those whose Business in Surgery, may turn to *Chiselden*, *Cowper*, or any distinguished Anatomist of that Profession. One Thing however, which is the Consequence of the Motion of these Muscles, and those of the Tongue and Jaws is not to be omitted, and that is the discharge of a clear bright Juice or Spittle from the salivary Glands, which gives the first Dilution and Change to the Food while chewing, and therefore this may be a proper Place to describe their Situation, Form, and Uses.

Of the SALIVARY GLANDS.

Parotis, or *Maxillaris Superior*, is the largest of the *Salivary Glands*; it is situate behind the lower Jaw, under the Ear; its *excretory Duct* passes over the upper Part of the *Masseter* Muscle, and enters the Mouth through the *Buccinator*. This Gland has its *Saliva* promoted by the Motions of the lower Jaw. Its Duct passes over the tendinous Part of the *Masseter* Muscle, that it may not be compressed by that Muscle, which would obstruct the *Saliva* in it, though it is frequently said, that it passes over that Muscle, that it may be compressed by it, to promote the *Saliva*. In Sheep, Horses, &c. whose Jaws are long, this Muscle is inserted far from the *Center of Motion*, that the End of the Jaw may be moved with sufficient Strength, and that distant Insertion requiring a greater Length of Muscle, that its Motion may be quick enough, no Part of this Muscle could be allowed to be tendinous; therefore, it seems, to avoid the Inconvenience of Compression from the Muscle, the Duct in those Animals goes quite round the lower End of it. When this Duct is divided by an external Wound, the *Saliva* will flow out on the Cheek, unless a convenient Perforation be made into the Mouth, and then the external Wound may be healed.

Maxillaris inferior is situate between the
lower

lower Jaw and the Tendon of the *Digastrick* Muscle. Its Duct passes under the *Musculus mylohyoideus*, and enters the Mouth under the Tongue, near the *Dentes incisorii*.

Sublingualis is a small Gland situated under the Tongue, between the Jaw and the *Keratoglossus* Muscle. Mr. *Chiselden* says, that in a Calf, he found several Ducts of this Gland; filled by an Injection into the Duct of the *submaxillary* Gland; but *MORGAGNI* and others shew, that the Ducts of this Gland enter the Mouth directly from the Gland in several Places near the grinding Teeth.

Tonsilla is a globular Gland, about the Bigness of a hazel Nut, situate upon the *Pterygoideus internus* Muscle, between the Root of the Tongue and the *Uvula*. It has no Duct continued from it, but empties all its small Ducts into a *Sinus* of its own, which *Sinus*, when the Gland is inflamed, may easily be mistaken for an *Ulcer*. This Gland with its Fellow, direct the masticated Aliment into the Pharynx, and also serve for the *Uvula* to shut down upon when we breathe through the Nose. They are compressed by the Tongue and the Aliment, when the former raises the latter over its Root, and thereby opportunely emit their Saliva to lubricate the Food for its easier Descent through the *Pharynx*. A scirrhous Tumor of either of these Glands is a common Disease, and it admits of no Remedy but *Extirpation*.

Pressure.

Pressure upon the Surface of a Gland very much promotes the Secretion, that is made in it; these Glands are so seated as to be pressed by the lower Jaw, and its Muscles, which will be chiefly at the Time when their Fluid is wanted; and the Force with which the Jaw must be moved, being as the Dryness and Hardness of the Food masticated, the Secretion of the Glands depending very much upon that Force; it will also be in Proportion to the Dryness and Hardness of that Food, as it shall be necessary; for all Food, being to be reduced to a Pulp, by being broke, and mixed with *Saliva*, before it can be swallowed, and made fit for Digestion, the drier and harder Foods needing more of this Matter, will from this *Mechanism* be supplied with more than moister Foods, in about that proportion, in which they are drier and harder, and the drier Foods needing more *Saliva* than the moister is the reason, why we can eat less and digest less, of these than those. What Quantity of *Saliva* these Glands can separate from the Blood, in a given Time, will be hard to determine, but in eating of dry Bread it cannot be less than the weight of the Bread; and many Men, in a little Time, can eat more dry Bread than twice the Size of all these Glands; and some, that are not used to smoaking, can spit half a Pint in the smoaking one Pipe of Tobacco; Persons in a Salivation, have spit, for Days or Weeks together,

gether, a Gallon in four and twenty Hours; and yet, I believe, all these Glands put together, do not weigh more than four Ounces.

The *Membrane* which lines the *Mouth* and *Palate* and covers the *Tongue*, is every where beset with *small Glands*, to afford *Saliva* in all Parts of the *Mouth*, in order to keep it moist; for those more remote are chiefly concerned in Time of *Mastication*. These small Glands have Names given them according to their respective Situations, as *Buccales*, *Labiales*, *Linguales*, *Fauciales*, *Palatinæ*, *Gingivarum*, & *Uvulares*.

A GLAND is chiefly composed of a *Convolution* of one or more *Arteries* of a considerable Length, from whose Sides arise vast Numbers of *excretory Ducts*, (as the *Lacteals* arise from the Guts,) to receive in each Gland their proper Juices, as the same *Lacteals* do the Chyle; and tho' the larger *Secretions* are made by *visible GLANDS*, yet *unconvolved ARTERIES* may also have *excretory Ducts* for the same Purpose. And this way, I imagine, *Secretions* are made from all the *Membranes* that line *Cavities*, and some others. There also arise, according to the old *Hypothesis*, from these *Arteries lymphatick Vessels*, to take off the thinnest part of the Blood, where a thick Fluid is to be secreted, seeing they are found in greatest Plenty in such *Glands* as separate the thickest Fluids, as in the *Testicles*, and *Liver*; and it is observable, that where the

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thickest

thickest Secretions are made, the Velocity of the Blood is the least, as if it was contrived to give those seemingly more tenacious Parts more time to separate from the Blood. The *Arteries*, that compose different Glands are *convolved* in different Manners; but whether or no their different Secretions depend at all upon that, I doubt, will be difficult to discover. The *excretory* Ducts arise from the *Arteries*, and unite in their Progress, as the Roots of Trees do from the Earth; and as different Trees, Plants, Fruits, and even different Minerals, in their growing, often derive their distinct, proper, nutritious Juices from the same Kind of Earth; so the *excretory* Ducts, in *different Glands*, separate from the *same Mass of Blood* their *different* Juices: But what these different Secretions, depend upon, whether the Structure of the Parts, or different Attractions, or what else, we have no *Certainty* about, though this Subject has employed several ingenious Writers. This Author says, for his own Part, from the great Simplicity and Uniformity usually seen in Nature's Works, which is most inclined to think different Secretions arise from different Attractions, seeing that in Plants and Minerals there seems to be no other Way, of accounting for the same.

Having said thus much of the *Salivary GLANDS*, and shewn their Use in administering the first Juices to moisten and lubricate the Food;

Food; we resume the Subject, from whence, for the Sake of describing these necessary *Appendages*, we made a Digression.



C H A P. XIV.

Of the Situation of the Stomach, and its Coats.

THE *Food* being ground by the *Teeth*, and moistened by the *Saliva* and *Juices* from the *Glands* of the *Mouth* and *Throat*, and then protruded by the action of the *Gullet*, is, in this mixed Condition, received into the *Stomach*, the grand Organ of *CHYLIFICATION*; which seems to take this Name from a *Greek* Original, in which Language it has also other Denominations, as γαστήρ, and κοιλία, from its Cavity. In *Latin* it is called *Ventriculus*, without any Addition to distinguish it from the other *Ventricles*, which have always some other Word added to determine their Signification, as *Ventriculus cordis*, *Ventriculus cerebri*. In *Man* the *Stomach* is but one: but such *Quadrupeds* as chew the *Cud*, especially all that are horned, have four; the first of which is called μεγάλη κοιλία, in *English*, the *Paunch*; the second, περύφαλ, in *Latin*, *Reticulus*; the third, ἐχίν, *Omasus*, in *English*, the *Feck*; the fourth, ἄνυστρον, or *Abomasus*, in *English*, the *Read*. Such *Fowl* also

as live upon Corn have two Stomachs; the first membranous called *Ingluvies*, the *Crop*; the second carnos, called *Ventriculus Carnosus*, in *English*, the *Gizzard*. The Stomach in Man is placed immediately under the Midriff, which it touches; wherefore if it be too full, it causes a Difficulty of Breathing, by hindering the Motion of it. In the Fore-part on the Right-side it is covered with the hollow Part of the Liver; on the left, it is touched by the Spleen: towards the Back, by the *Aorta* the *Vena cava*, and under it, backwards by the *Pancreas*, and at bottom by the Caul, &c. all which Connexions serve to encrease its Heat.

As to the Form of the Stomach, it represents an oblong Pouch, somewhat broader at Bottom, and expanded in an orbicular Form, while its Top is more upon a Plane, and shorter: its Orifices are opposite, the Gullet before described, which is on the left Side, descends perpendicularly, and conveys to it the Aliments, which being there dissolved and turned into CHYLE, ascend by the right Orifice, where the Duct is oblique, and are thence conveyed into the Intestines. So that whatever goes out from either Mouth of the Stomach must do it by a steep Ascent; and that it may discharge its Contents either on the left Side, by vomiting, or on the right, by siege, it is necessary, that both its Bottom and Sides be at the same Time contracted, raised upwards, and then totally inclined to this or the other

other Orifice: The Size of the Stomach has been observed to be less in Women than in Men, to give Way to the Distention of the Womb; and moreover, it is remarked that People, who have wide Mouths, have generally the larger Stomachs.

Thus much of the external *Figure* and *Situation* of the *Stomach*; one should consider likewise its *COATS*, and the *Texture* of its *FIBRES*; its *Orifices*, *Vessels*, *Ducts*, their *Actions* and *Uses*. The *STOMACH* then, as the *GULLET*, consists of *three* Coats, one *Common* from the *Diaphragm*; and two proper, the *external* and *internal*.

The *internal* Coat is entirely *nervous*, whose internal Superficies, as was observed of the *GULLET*, is a *Shaggy* Substance with Filaments erect, like Velvet; the Uses of this Shag, and that of the Gullet, are to retain for a little Space the Particles of Things tasted and swallowed, before they reach the Nerves, which would be too much irritated by an immediate Contact. Moreover, the Relicks of the Chyle being there retained, and fermenting a little, pass into a ferment, necessary both for Appetite and Digestion. *HUNGER* being an uneasy Sensation, caused by the *Acrimony* of these Particles, which affect the wrinkled Membrane, especially about its upper Orifice, and produce a Twitching, which being communicated by the Nerves of the 6th Pair (Dr. *WILLIS*'s 8th) to the Brain, an Imagination

of taking Meat is excited to assuage the troublesome Corrosion, and procure some Ease to the Part affected. This Shag likewise covers the Mouths of the Vessels, which are every where thick inserted in the nervous Coat, and receives the Humours oozing from the Nerves and Arteries. This villous Coat, on its Back or convex Superficies, where it adheres to the nervous Coat, is surrounded by a Number of annulated Glands, which cover the gaping Mouths of the Vessels in the nervous Coat, and receive or strain the Humours coming from them, or destined for their Use.

This Veil of Shag is easily separated, by being immersed in warm Water, and appears to be a covering pretty firm, and distinct from the rest: and, for the reason just mentioned, may not improperly be called *glandulous*. This inner Coat of all, in healthy Bodies, has many Wrinkles, or FOLDS, which serve as so many Furrows for detaining the CHYLE in separate Portions, and forming a better Concoction than could be expected, if it all immediately ran together into a thicker Mass.

Those Folds are formed by reason that this Coat is more ample than the carnous, which contains it. But in Gluttons and Drunkards, the *fleshy* Tunick being continually extended by their Intemperance, the *interior* has room to be extended with it, and so loosing all its Wrinkles, it becomes as plain and thin as a blown Bladder.

As

As to the *nervous* Coat, its Fibres are chiefly instrumental to Sensation, they may contribute something to Motion: but with respect to Sensation; when they are emptied, they excite Hunger, as when they are irritated by Saltness or Dryness, or heated by Aromatics and vinous Liquors they bring on thirst; and again, when stimulated by sharp or sour Humours, they create the Heartburn. Lastly,¹⁶ it is upon these Fibres, that Medicines perform their first action; and according to the sensible Impression made upon them, the Operation, of whatsoever sort it be, is to look for its Success. So soon as by the Administration of proper Aliments these Fibres are replenished, there arises a Complacency to the Spirits, that occupy these Parts, and by their Communication or Consent, a Chearfulness and Refreshment to their whole System, that is to say, to the *Anima Sensitiva*, or Soul of Sense; at the same time, as the Veins imbibe the more subtle Portion of the Chyle, there is also a richer Nourishment afforded to the *vital* Flame.

As to the Motion of this Coat just hinted at above, tho' Dr. WILLIS, denies that it has any *spontaneous* Motion: yet he says, that it may be distended and swelled, not only by Flatulencies in the Stomach, but also much oftener by the hurry of the Spirits contained in its Fibres, which often, by their explosive Force, blow up that Membrane like a Bladder. Hence the SWELLINGS of the *Ventricle*,

in *Cholicks*, *Hystericks*, and *Hypochondriacal* Cases, &c. lastly, deleterious Medicines and Poisons, as they violently stimulate the Spirits, and drive them furiously into these Fibres, bring on dreadful Inflations and Distentions both of the Bowels and Stomach. To which kind of Causes the same Physician insinuates, that the origin of a Tympany ought to be ascribed.



C H A P. XV.

Containing a Further Account of the Coats of the Stomach, &c.

THE next COAT is the fleshy, which is also called *proper*, and covers the whole Body of the Stomach with its elastick Fibres, which are disposed in different Directions, and in a most astonishing Manner, to serve its different Motions, and Contractions. As those Fibres are not easy to be described, on Account of their Intricacy, and yet very necessary to be understood, in order to judge of the Operations of Medicines, or the Actions of the Stomach; Dr. WILLIS has taken particular Pains about this Part of Anatomy, which, he says, was little examined into before his Time. He supposes the Stomach of a Man or Sheep, to be discharged of its Contents,
and

and after applying proper Ligaments blown up like a Bladder. Thus prepared, it is to be dipped into boiling Water, till the whole is parboiled: and then may easily be discerned the Texture of the *outer Coat* or Membrane, that *covers the whole* Stomach. The FIBRES of which run *lengthways* from one Orifice to the other, in a Form more or less inclined to circular, according to the Extension of the Stomach, and in a Series one above another. Moreover, in some Places, as, for Instance, near the Orifices, the Bottom, and the Ends, they are so much larger than in the Middle, that they appear in some sort carnous, and capable of Motion. The nervous Fibres of this outer Membrane cut the carnous, which lie immediately under them, at right Angles, as being intended not only to cover them, but to bind them together, and keep them in their proper Position.

The first or outward COAT being removed, these *carnous* FIBRES of the *second* appear. They are partly *annular*, encircling the Stomach from the Bottom to the Top; their Axis is a Sort of horizontal Curve bending from the *Pylorus*, and issuing about the Middle of the left End of the Stomach, below the *Aesophagus*. Their Office is by Contraction to raise the Bottom and the Sides of the Stomach *upward*, and so to lessen its Cavity, that the Contents may be discharged, by one or the other *Orifice*, as the *Internal* Series of Fibres shall

shall direct, as some of them lie with Respect to these in an Order quite transverse. That there are such *Fibres* in this *Coat*, lying under the *Exterior Annular*, will appear to any one, who views the Inside of it, which is done by making an Incision at the *Pylorus*, and turning it inside outwards, by which means the *shaggy Coat*, and the *Wrinkles* before described appear. Afterwards, by a slight immersion into boiling Water, this *villous Coat* may also be removed; and then may be seen that which is called the *nervous*, all overspread with the RAMIFICATION of the *Vessels*; this being stripped away likewise, there will then appear the FIBRES of the inner *Superficies* of the *middle* or *fleshy Coat*, as they are curiously exhibited in the 5th TABLE of this accurate Author: It is remarkable in the Distribution of these FIBRES, that such of them, as arise behind the Mouth of the Ventricle, and seem to surround the left Side of it, are carried directly forward along the Top of the Stomach to the right Side, and enter in this Manner the Cavern or Den of the *Pylorus*, and terminate in the Orifice, whereas the remaining Fibres descend obliquely by the Side, and meet at the Bottom. The Business of the *first Order* seems to be the drawing of each *Orifice* near to the *other*, for carrying off the Contents by one *Passage* or the other. Seeing that these Fibres draw the Stomach to the left or the right, just as the Spasm begins at the right End of them, or the left. The

The business of the *oblique* or *annular* Fibres, as well *internal*, as *external*, is to assist the former Operation of Discharge, at either Orifice, by compressing the *Sides*, and lifting the *Bottom* of the Stomach. And we may observe by the Way, that the Impulse or Instinct which produces these Motions in the carnous Coat, may arise from Causes somewhat different. The first and principal no doubt, is the Disposition of the *nervous Coat*, which lieth under it. For as that is affected by the *Contents*, it draws the other for the Sake of *Retention*, or *Expulsion*, into *different* Directions. Not but the NERVES from the *Brain* may convey, as that is affected, Impressions and Instincts likewise. Hence it is, that FANCY, APPETITE, or any DISORDER of MIND, or BODY, shall have a surprizing Influence, and Effect upon the STOMACH.

As for the *outermost* Coat of the Stomach, which is *common* to it and the gullet; and of what Substance and Texture it was, we have made some Observations before. And for its Use, it serves as a *general Tegument* of the whole; cloathes the *carnous* FIBRES of the Coat beneath, and binds them together with its own. The FIBRES of this outer Membrane, as has been before observed, are in some Places uncommonly *thick* and strong, to the End, that when the *Ventricle* is stuffed beyond Measure, they may be able to sustain a
more

more than ordinary *Extension*. The *Fibres* of this Coat can contribute but little to MOTION, though in some Cases they are the Instruments of Sense, not that any outward Object, or any thing received by the Mouth can affect them; but if there be a Discharge of the ferrous Humour, or an Abscess, or a constant Suffusion of Bile, in the contiguous Parts as this Coat will thereby be much and frequently *irritated*, there must ensue a continual *Squeamishness*, or Sickness of the Stomach, want of *Appetite*, and frequent *vomiting*, which Dr. *Willis* found to be the Cause upon dissecting dead People, who had been thus affected. Beside, that it is a common Tegument, and sustains the *Ramifications* of the *Vessels*; this COAT gives *Strength* to the Stomach, and greatly preserves its HEAT; nor is it improbable, but that its *Fibres* may, upon some Occasions, serve as Tendons to the carnous ones, which lie underneath.

Having given this Account of the STRUCTURE of the STOMACH itself, we proceed to its other *Orifice*, commonly called the *Pylorus*, which lies on the right Side. It has a long and capacious *Entrance*, which is gradually lessened till it ends in a small Passage, and thence being bent backward is continued in the *Duodenum*. The *Coats* are here much *thicker* than in other part of the Stomach. The *inner Nervous* is here remarkably rough, with Wrinkles and Furrows, and raised in the
very

very Passage into a Substance of an oblong Form, to hinder the Chyle, which is discharged into it, by little and little, from returning back, and regurgitating into the Stomach again.

The *carnous Coat* contains here as in other Places *two Rows* of FIBRES, some of which surrounding this *Antrum*, or Cave, constrict and shut it: while others, which are drawn out in a long Direction, gather up the other Parts of the Stomach, and attract them to this opening. And so, *vice versa*, the Contraction beginning from the other End, these very Fibres draw the *Pylorus* to the left Orifice, as in the act of Vomiting; and when that is further continued, the *Duodenum* also is lifted up, and by that Means the *Bile* and *pancreatic Juice* are pumped into the Stomach.

The Office of the *Pylorus* is not only to discharge in greater Quantities the Contents of the Stomach, and transfer them continually to the Bowels (as is the case in *Purgations*, or a *Diarrhæa*) but also to receive the *Chyle* into its Cavity, especially, that which is *sufficiently* concocted, and there retaining it a Time, to excrete and let it out in little Quantities. For this *Antrum* or *Den* being a Cavity long and large, seems designed for a Store-cellar, into which the Portion of the Mass of CHYLE, which is first prepared, may be carried and deposited, till such Time, as the cruder Sort, which has been later introduced,
has

has had its due and stated Digestion, in the Bottom of the Stomach by Means of this Order and *Gradation* it is, that things disagreeable to the Stomach are by natural vomiting often cast forth again, while those, which are agreeable, continue still in a State of Digestion, and keep their Place. Forasmuch as in the *Ventricle*, there are many different *Cells*, into which the different Sorts of Aliments at different Times descending, may form their Separation, and for their proper Time remain.

With respect to the Exit by the *Pylorus*, HALLER observes, “ *Quod primum Paratum fluidumque est, id præit, hinc omnium primo aqua, et lac, deinde Olera, ultimè Carnes sequuntur. Duriores, Tenaciores, longiores pelles Fibræque unà transeunt immutatæ; et Dura sed crassa pro Pylori Portione Corpora diutissimè retinentur.*”

As to the Production of the CHYLE itself, the Reader may take this short Account, extracted chiefly from Dr. Charleton's *Prælections* before the College of Physicians in London: “ While the Meat is chewing in the Mouth, it is mixed with the Saliva, which not only softens it, but endows it with a certain fermentative Quality, unto which contributes also the Drink (whether Beer or Wine, or any other) which often contains in it acrimonious Particles, and fermentaceous Spirits. The Stomach, by the help of its Fibres, embraceth closely the Meat thus chewed

“ chewed and swallowed, and mixeth there-
 “ with specifick fermentaceous Juices bred in
 “ its inner Coat, and impregnated with the
 “ *Saliva*” (which beside that collected in
 chewing and swallowing, descends continually,
 according to *Haller*, at the rate of half an
 Ounce the hour) “ by Means like these, and
 “ the Heat and Action of the Stomach, and
 “ adjacent Parts, there is made a Mixture of
 “ all the Meats, in Resemblance like a milky
 “ Cream. After which, together with the
 “ thicker Mass, it passes into the Guts. Where
 “ by the Tincture of the Gall and pancreatick
 “ Juice, it undergoes another Fermentation,
 “ and so the thinner Parts of the Food are
 “ received by the lacteal Vessels, as the thic-
 “ ker are ejected by Stool.” Thus much of
 the Structure of the Stomach, and its internal
 PARTS and OPERATIONS: which, however,
 could not well be performed, without its *ex-*
ternal Parts and APPENDAGES, such as its
 NERVES, ARTERIES, and VEINS, &c. The
 first of which, beside their Office of *Sensation*,
 serve, according to *Boerhaave*, to bring Abun-
 dance of nervous Juice for the Work of Di-
 gestion; “ *Vim forte Liquidi nervosi vix alibi*
 “ *Copiosioris, &c.*”

The NERVES are those of the *Par vagum*,
 or wandering Pair, which extend to the Ven-
 tricle as their utmost Boundary; they form so
 many Plexuses about the *Pylorus*, as to resem-
 ble a Piece of Net-work, which indeed covers
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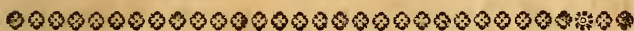
the whole Circumference. Moreover, the villous and nervous Coat of the *Oesophagus* extend very deep into it's Cavity, by Reason of this Sensibility, and its Communication with other noble Parts, as the *Præcordia* and the Brain, we cannot so much wonder that *Van Helmont* imagined this Orifice of the Stomach to be the Seat of the Soul; the Manner in which the Branches of the *Par vagum* insinuate themselves into the Stomach, may be seen in Books of Anatomy, and easily accounts for the great Consent between the Stomach and the Head: so that in any great Concussion of the Head, there follows a Vomiting, and from the Foulness and Disorder of the Stomach, the Head-ach.

Beside the *Par vagum*, the nervous Plexuses of the intercostal Pair, which are thick set in the Hypochondrias and the Abdomen (according to Dr. *Willis*) send many remarkable Branches to the Ventricle; which is the Reason why a vomiting so frequently succeeds either in Cholics, or hysterical and hypochondriacal Affections.

The Stomach hath *sanguiferous* Vessels in great Number, both *Veins* and *Arteries*. The Veins arise either first from the Trunk of the *Vena portæ*, and this is the *Pyloricus ramus*; or secondly, from the Branches of the same, as from the *Ramus Splenicus* it hath *Gastrica minor*, and *Gastrica major*, the largest Vein in the Stomach, from whence the *Coronaria* is deduced

deduced, *Gastroepiplois sinistra* and *Vas breve*; and from the *Ramus mesentericus* before it is divided, it hath *Gastroepiplois dextra*.

The Arteries come from the *Ramus celiacus*, accompany every Vein, inosculate with them in a wonderful Manner, and take the same Denominations.



C H A P. XVI.

Of the Entrails or Bowels, in general.

FROM the Stomach we descend to the *Entrails*, which are probably so called from the *Greek Word*, *Ἔντερα, παρὰ τὸ ἐντὸς εἶναι*, as being placed within the Body. To this Meaning corresponds the *Latin Intestina*, but in real *English* this whole Channel, and its Variations are called the Guts. They are knit together by the Mesentery, by which, and by the Intervention of the Caul (to which part of the Colon is affixed) they are tied to the Back, and fill the greater Part of the Cavity of the Abdomen, being sustained by the Cavities of the *Os Ilium*.

They are generally six Times the length of the Party, to whom they belong: and notwithstanding their Extent are connected and sustained, except at their Beginning and End, and the Part of the Caul aforementioned, by

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the Margin of the Mesentery, which is a Circumference not above a Span distance from its Center. It is however divided into so many Folds and Windings, that according to Dr. *Willis*, were all the Plaits and Gatherings unfolded, it would amount to three Yards in length, *trium Ulnarum Longitudinem*, &c. He says farther, that every Hand's-breadth, or Palm of the Mesentery, contains 12 Hand's-breadth of the Guts. These Windings not only serve to keep the Parts distinct, which otherwise would be oppressed and confounded lying in so small a Compass; but also by staying the Aliments so long in their Passage from the Stomach, afford them time to be more thoroughly fermented by the Mixture of the Bile and pancreatic Juice; that so the more subtle chylous Parts might be the more effectually, and leisurely driven into the narrow Orifices of the lacteal Vessels, partly by the proper peristaltic Motion of the Guts, and partly by the external Force, and Compression of the Muscles of the Abdomen, moved in Respiration. And hereby two great Inconveniencies are avoided; the one of continual Eating, which must have been the Consequence, if the Aliments had passed so quick, as not to afford Time enough for the Chyle to be elaborated and distributed in such a Manner, as the due Sustenance to the Body must require: which again would produce another Inconvenience, to wit, the continual Necessity of going to Stool.

All

All the Intestines have three Coats as well as the Stomach; one common and outermost, from the *Peritonæum*, but mediately; for in the *Duodenum*, and that Part of the Colon, which cleaveth to the Stomach, it proceeds immediately from the lower Membrane of the Caul; and in the *Jejunum*, *Ileum*, the rest of the *Colon*, *Cæcum*, and *Rectum*, it proceeds from the Membranes of the *Mesenterium*. It is all over besmeared with Fat, and is truly nervous.

Beside this *common* Coat, the Bowels have two *proper*. The outer of which being the Middle of the three, is carnous. It has two Ranks of moving Fibres, one lying under the other. The first or inner Rank is annular or transverse, which encompassing the whole Cavities of all the Intestines in very close Order, is inserted into the Hem, or Seam of the Mesentery, as into its Tendon. The other Rank consists of streight Fibres, which being spread above the Former, and cutting them at right Angles, reach along the whole Length of the Intestines; and their Tendon seems to be the outmost Coat, which being wholly or throughout nervous, and at the same Time somewhat tendinous, is rolled about this whole Rank of Fibres.

The innermost Coat is nervous, although it seems to be fleshy, by Reason of the crusty Substance with which it is lined, which is framed of the third Concoction of the Guts

themselves. This Lining is called by *Pecquet*, a spongy *Peristoma*; by *Bilsius*, a woolly Moss. It serves as a Filtre, through which to transcolate the Chyle, in order to its Entrance into the *Venæ Lactææ*, besides it hinders Excoriation, which otherwise might happen, when any very sharp Humours pass through the Guts.

Some (as particularly *Dr. Willis*) take it for a distinct Coat, and call it *glandulosa Tunica*, or *Villosa*: but one of my Authors, *Dr. Gibson* supposed it to be an *Epiphyfis* or Excrescence upon the other, arising from the Cause before mentioned.

This Membrane in the small Guts, especially the *Ileum*, is full of Wrinkles, to stay the Chyle from passing too soon. The Cause of these Wrinkles is its Length: for if they were stretched open (according to the observation of *Fallopious*) this Coat in itself is thrice as long, as that, which is next above it.

The same Membrane is expanded in the *Colon* into little Cells, for the slower Passage of the *Fæces*. It has all sorts of Fibres, and contains the Mouths of all the Vessels both sanguineous and lacteal, which are covered with that spongy Crust before mentioned:

In regard to the peristaltick Motion, as well as for the Purposes above recited, all these Coats and Fibres have their Use, for driving on the Chyle and *Fæces* in their mixed State, as also for pressing the more subtle parts of
the

the Chyle into the lacteal Vessels and meseraick Veins, the circular Fibres contract themselves successively, or in a Series; this diminishes in some Degree the Diameter of the Intestines, which is still reduced to a narrow Compass by the Inflation or Swelling of the Longitudinal Fibres: yet at the same Time, we are not to think, that the Contractions of both Kinds are so continual, that the Contents of the Intestines are all of them at the same Time forced on together (though this may sometimes happen, in a strong Purging or violent Looseness) for ordinarily those Spasms are of a lighter Sort, interrupted in Time, though succeeding in a gradual Order, and repeated in such a Manner, that the *Chyle* and *Fæces* may still be gently moving from Place to Place.

If it be inquired by what Instinct, the Fibres of both Sorts, as well annular as longitudinal, are put in Motion, and this or that Part in their Order thereby contracted: I answer, that the Motions of the carnous Coat, whether in the Stomach or Intestines, depend upon the Feelings of the nervous Membrane, so that these follow as that is irritated. So soon as any Thing disagreeable communicates to the nervous Fibres an uneasy Sense, the moving Fibres contract the Part affected to expel the Burthen.

The Irritation of the nervous Fibres in the ordinary and more kindly Course is occasioned,

first by the Reliques of the Chyle. While the better Part of that is distributing, the Fibres, which lie before, are contracted, that it should not slide away too soon; but after the Distribution the Spasm or Contraction happens from behind, to forward the Discharge of the Remainder. A second Sort of Irritation may arise from a more abundant discharge of the Bile and pancreatick Juice, and from a Suffusion of sharp Humours from the Arteries. The third Sort, which is preternatural and more vehement, may come from the Disagreeableness, or improper Quantity of the Aliments, from Medicines, or from Poisons.

Further, there are other more remote Causes of the Contractions in the carnous or moving Fibres: violent Passions of the Mind or Body will frequently be attended by a *Diarrhæa*. For in these Cases the Spirits in the Brain being put into a great Commotion, convey their Disorder by the Canals of the Nerves to the animal Spirits in these lower Regions, and produce such eckoprotick Spasms.

As to the Vessels of the Intestines, the Veins are chiefly appendent to, and advance towards, tho' others say, proceed from the *Porta*, altho' not from the same Branch. For the *duodenalis Surculus* is sent into the *Duodenum*, and the *Hæmorrhoidalis interna* to the left Part of the *Colon* near its Ending, and thence running under the *Rectum*, is inserted into its End or *Anus*; as the *dexter Mesentericus* is sent to the *Jejunum*, *Ileum*, *Cæcum*, and the right Part
of

of the *Colon*; *Epiplois postica* is inserted into the middle Part of the *Colon*, and proceeds transversely under the Stomach: besides these a Sprig from the *ramus Hypogastricus* of the *Vena Cava* is sent to the Muscles of the *Intestinum rectum*, which makes the external *Hemorrhoidal*.

As to the Use of the *Meseraick* Veins, there are many learned Anatomists, who still think that tho' the greatest Part of the CHYLE is received by the *Venæ lacteæ*, yet that some Part is sucked in by these Veins, to be more readily conveyed into the Mass of Blood; others deny it. *Boerhaave*, however Speaks of certain *absorbent* Vessels, which minister to these Veins *Venarum mesentericarum in homine aperti in Tunica villosa Fines—*. And ask—*an non tenuis biliosa, et lymphatica magis Pars illius Chyli recipitur fistulis absorbentibus hiantibus in Intestinorum Crustâ, et se exonerantibus in Venas Meseraicas, unde in Vena Portarum Dilutio, Bilique secernendæ nova Materies?*

Beside these sanguineous Veins, there is another sort, which are inserted more or fewer into all the Guts, and are called *lacteal*: but these will require a distinct Account, and therefore from the sanguineous Veins we proceed to the Arteries.

These spring partly from the *Ramus cæliacus Intestinalis*, partly from both the *Mesentericæ*. To the *Duodenum*, and the Beginning of the *Jejunum*, a Sprig is sent from the right *Ramus*

Cæliacus; but to the Rest of the *Jejunum*, the *Ileum*, *Cæcum*, and the right Part of the *Colon* comes the *Mesentericus superior*, to the left Part of the *Colon*, and to the *Intestinum rectum* the *Mesentericus inferior*. This last passing along the *Rectum* to the *Podex*, makes the internal hæmorrhoidal Arteries, as some Branches from the *Arteria hypogastrica* make the External. At the last *Epiplois postica*, which rises from the lower Part of the *Arteria splenica*, which is the left Branch of *Arteria cæliaca*, is transmitted to the middle Part of the *Colon*, which lies under the Stomach.

Though authors differ about the use of the Veins, they seem to agree, that the Use of the Arteries is to convey Nourishment and Warmth to the Guts: and when the Body is distempered, to carry thither the Impurities of the Blood; that upon a Crisis of Nature, or a Purge, they may pass off by Stool.

The Nerves in these Parts come from the inferior Ramifications of the Intercostals. The *Duodenum* hath some Twigs from the upper Branch of the *Ramus mesentericus*, called *Stomachicus*, which also go to the *Pylorus*. All except the *Rectum* have many Twigs from the *Plexus mesentericus maximus*, arising from under the great Gland of the Mesentery; but the *Rectum*, with the latter End of the *Colon* receive Slips, from that Branch of the Intercostal, which is called *Plexus Abdominis inferior* or *minimus*, and the utmost Extremity of the

the Intercoſtal is inſerted into the *Sphincter ani*, whither alſo paſs three or four, that Spring from the Bottom of the *Os Sacrum*. Theſe Nerves ſerve to give Senſe, or the periltaltick or wormlike Motion of the Guts, which tho' it be obſcure and flow, yet becauſe it is continual, has need of ſo great a number of Nerves and nervous Fibres, as are beſtowed upon the Inteſtines to carry it on. The learned and curious, who would be further informed about the Periltaltick Motion may conſult Dr. *Gliffon*, Cap 15. *De Ventriculo & Inteſtinis*, or Dr. *Charleton*, Sect. 3. of his Third *Prælection* before the College of Phyſicians.



C H A P. XVII.

Of the Diviſion of the Entrails into thin and thick, or great, and ſmall Guts.

THE *thin* or *ſmall Guts* poſſeſs the umbilical Region, and *Hypogaſtrium* : and in reſpect of their Figure, Situation, Longitude, and Plenty of lacteal Veſſels, they are divided into three, to wit, the *Duodenum*, *Jejunum*, and *Ilium*.

The firſt is called *Duodenum* from its reputed Length of twelve Inches. It paſſes from the *Pylorus* under the Stomach towards the Spine, and

and is sustained in its Passage by the Membrane of the Caul, and not the Mesentery. It reaches as far as the left Kidney, to which, and the *Vertebræ* of the Loins, it is tied by membranous Ligaments ; and going a little lower, it ends under the *Colon*, where the *anfractus* or Winding of the two following small Guts begins. *Haller* describes its passage to be—
 “ *undulatum sed in universum transversum dextrorsum & retrorsum in vacuo ventriculo ad vesicam fellis migrat, cujus cervicem contingit,*”
 &c. *Chiselden* says, “ That from the *Pylorus* it is reflected downwards, and first passes by the Gall-bladder, then under the following Gut and the Mesentery, and coming in Sight again in the left *Hypocondrium*, it there commences *Jejunum*, which is the second of the small Guts, but the Place where this ends, according to this Author, is not precisely determined.” What differences there may be in these Accounts of Anatomists, may be owing to the Variety of Appearances in different Subjects. Towards its lower End the *Duodenum* has sometimes higher, sometimes lower, most commonly two Ducts leading obliquely into it. The first is the *ductus choledochus communis*, by which the Bile from the Liver enters : the second, a little below this, is the *ductus pancreaticus*, by which the pancreatick Juice passes hither from the Sweet-bread : though these two Ducts are sometimes joined into one ; and both open by one Mouth into this Intestine, sometimes,

times, but rarely, they are inserted into the *Jejunum* or hungry Gut,

This is the *second* in Order, and obtains that Name, because for the most part it is found empty; partly by Reason of the Multitude of milky Veins, that enter it; partly by Reason of the Fermentation of the acrimonious Choler, with the pancreatick Juice, which are both poured in just before its Beginning. In length it is twelve Hand-breadths and three Inches, it begins on the right side under the *Colon*; this contradicts what *Chiselden* had advanced before, who brings it from the left *hypochondrium*. *Haller* deduces it in the following manner—" *Per foramen proprium in quo*
" mesocolon transversum sinistrum & mesenterium
" ipsi adnascuntur descendit in inferiorem partem
" abdominis, hanc subit, & nunc jejunum est."
 These two latter *Anatomists* seem to allow too long a Measure to their *Duodenum*, not considering the Difference between Twelve, and Twenty-four. If they could not find an end of that Gut by any natural Limits or Marks, the reputed Measure should have determined the Extent, seeing it is all but one pipe, and the Name arbitrary, and meant to signify nearly, though perhaps not precisely, such a Part of the Whole. My old Anatomist however, says, beside this, that it may be distinguished from its very Beginning by the wreathing of the Guts, and that filling almost the whole *umbilical* Region, especially on the left *side*, it tends into the *Ileum*, from which it may be distinguished
first

first by its *Emptiness* : *secondly*, by its great Number of *Veins* and *Arteries*, from which it looks reddish : *thirdly*, the Nearness of the Folds and Wrinkles of its inmost Coats one to another ; which are but about half an Inch distant, whereas in the *Ileum* they are an whole Inch asunder. These, if true, are essential Differences. Whereas if we take *Haller's* account, there are none so discernible— “ *Id tenue intestinum, quod infra hoc*
“ *Mesocolon est, omnino nullam certam Notam*
“ *discriminis admittit, qua jejunum Vulgo dic-*
“ *tum ab Ileo Separetur.*” And again, “ *Di-*
“ *versitas Sensim obrepit absque certo Limite.*”

But not to attend too long to this War of the *Anatomists*, we proceed to the Account of the next Bowel, called the *Ileum* (ἀπὸ τῆ ἐι-
 λαισθαι, a *circumvolvendo*) from its many Turnings and Windings. It hath thinner Membranes than the Rest of the small Guts; it is seated under the *Navel*, and fills both the *Iliac*. It is the longest of all the Guts. For it extends to twenty one Hand-breadths; but it is the narrowest of all, for it is not an Inch and an half in Breadth. It hath fewer Wrinkles than the *Jejunum*, and those less, which about the lower End of it scarcely appear.

It begins where the Veins appear smaller and fewer, and ends about the Place of the right Kidney, where it is joined both with the *Intestinum Cæcum* and *Colon*. And it is easily distinguishable from the *Colon*, for it is not joined to it by a straight Duct, but transverse.

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the *Colon* and *Cæcum* are so united, as to make one continued Canal, whose lower Side the *Ileon* ascending pierceth, and into which its inner Coat hangs loosely the Length of Half an Inch at least, making the *Valve* itself of the *Colon*, and is the very Limit, that divides the *Cæcum* from it.

When the *Ileum* falls down into the *Scrotum*, which frequently happens, the Rupture is called *intestinal*. This Gut is the Seat of the Distemper called *Volvulus*, or *iliaca Passio*, wherein there is often a Vomiting of the very Excrement. This Distemper is occasioned, either when one Part of the Gut presses too much upon the other, or when it is twisted like a Rope, or when it is stuffed with some Matter, that obstructs it; or lastly, when it falls out of its place into the *Scrotum*, as was noted before.

And thus much of the *small* or *thin* Guts, the *great* are also THREE in Number.

The *first* is called the *Cæcum*, or blind Gut, because one End of it is shut, and whatever enters returns by the same Orifice. It is about the Size of a great Earth-worm, and half its Length, from whence it has sometimes the Name of *appendicula Vermiformis*, it had never been reckoned among the great Guts, had the *ANTIENS*, from whom we take our *TERMS* in *Anatomy* performed their Dissections upon *Men*: but in *Dogs* and many other *Animals*, which were the Subjects of their Operations,
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it is very large. Some Fish have these *Appendiculæ* in great Numbers, though of a small Size. Mr. *Chiselden* says, that he has counted an hundred and fifty in a *Mackrill*. This Gut owes its Origin rather to the *Colon* than the *Ileum*, to which it seems to be an Appendage. It is not tied to the Mesentery, but being couched round, it is knit to the *Peritonæum*, and by its End it is joined to the right Kidney, the *Peritonæum* coming between. Its Use is very obscure in Men, being generally empty: but in grown *Fætuses*, and Infants new born, it is full of Excrements, for which it serves as a Storehouse, till they are enabled, after the Birth, to go to Stool.

The *second* of the great Guts, and truly so named, is the *Colon*, being the hollowest and widest of all. The Word is *Greek*, some suppose it to be taken from *κοῖλον*, *Cavum*; others from *κωλύειν*, *impedire*, because it detains the Excrements. It hath its Beginning, as was observed before, tranversely from the *Ileum*, but directly from the *Cæcum*. It arises at the *Os ileum* on the right Side, and ascending by its Spine, it arrives at the right Kidney; to which Parts it is annexed by a membranous Connection. From whence bending leftways, it creeps under the Liver by the Gall-bladder (which tinges it there a little yellowish) and thence goes to the Bottom of the Stomach, to the whole Length whereof it is tied, only the Caul coming between them, it has also Connection

nection with the *Pancreas*, and the Loins. Then it comes to the lower Part of the *Spleen*, and is knit to it. After that, touching the left Kidney, and adhering firmly to it by Fibres, it comes to the left *Os ileum*; from which descending by the left Groin to the *Pelvis*, it embraces the Bottom of the Bladder on each Side behind. Next it ascends upwards by the right Groin, near to the Place from whence at first it took its rise, and thence marching back again towards the left Side, and running itself betwixt the *Ileum* and the Back-bone, it reaches the Top of the *Os sacrum*, and there unloads itself into the *Rectum*. Its Length, according to Dr. *Glisson*, is about seven Feet; others reckon it shorter. It goes within a little quite round the *Abdomen*, next to the Muscles, that it may be the better compressed by them for the Avoidance of the Excrements. *Diemerbroeck* has an ingenious Reason why it should pass under the Stomach, supposing (as Chymists judge no Digestion more natural than that, which, is performed by the Heat of Dung) that the Heat of the the Excrements in the *Colon* may help the Concoction of the Stomach. It hath Cells, which spring from the *internal* Tunicle, which are kept in their Figure by a Ligament half an Inch broad, passing through the upper and middle Part of it all along; this being broken or dissolved, the Cells stretch out and appear no more. Their Use is to hinder the

the Excrements from gathering into one Place, which would oppress the adjacent Parts; another Use is to prevent the continual and hasty Occasion of going to stool.

This Gut, as was said, hath a Valve, where it is joined by the *Ileum*, which *Spigellius* compares to the *Sigmoides* in the *Sinus* of the Heart. It serves to prevent Flatuofities and Excrements from ascending to the *Ileum*, and is discovered by pouring Water into the *Rectum*, and holding up the Guts: if it be found, the Water will stay, when it comes to the Valve. If it be relaxed or torn away, excrements may be expelled by Vomit; and Clysters ascend into the Stomach, as it happens in the *Iliack* Passion.

The *Intestinum rectum* or streight Gut, hath its Beginning at the first *Vertebra* of the *Os sacrum*, passing streight down to the Extremity of the *Coccyx*. It is fast tied to both on the Back-side by the *Peritonæum*; and on the Foreside, it grows in Men to the Neck of the Bladder, whence in a fit of the Stone arises a continual Inclination to go to Stool; in Women it adheres to the Neck of the Womb. It is a Span in Length, not so wide as the *Colon*, but its Membranes are thicker. The *Anus* or Hole hath three Muscles. The *Sphincter*, which is fleshy, and encompasses the streight Gut. It is two Inches broad, and its Fibres are orbicular. It does not spring from any adjacent Bone, but only adheres to the *Coccyx*,
and

and serves to purse up the Fundament. The second and third are called *Levatores*, these spring from the Ligaments of the *Coxendix* and *Os sacrum*, being broad and membranous, from whence passing by the Sides of the straight Gut they stick to it, and are inserted into the upper Part of the *Sphincter*.

These hinder the falling out of the Fundament, which happens, when they are too much relaxed.

As for the *hemorrhoidal* VEINS and ARTERIES, they are inserted into the *Anus*.



C H A P. XVIII.

Of the Mesentery, Meseræum, and Mesocolon, the Mesaraick Lymphæducts, and Glands, &c.

THE MESENTERY is so called from being placed ἐν μέσῳ τῶν ἐντέρων, in the Midst of the Intestines. It is a *membranous* Part situated in the Midst of the *lower* Belly, serving not only for conveying some Vessels to the Intestines and others from them, but also it ties most of the Guts together so artificially, that for all their manifold Windings they are not entangled or confounded, which is a Matter of Wonder, since the Guts are generally nine or ten Yards, and yet all but the *Duodenum*, and a Piece of the *Rectum*, are comprehended

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hended by a *Circumference*, which is but a Span distant from the Center. *Cbeselden* makes the beginning of this Membrane from the Loins, about three or four Inches broad in the small Guts, which is about a fourth Part shorter than the other Side; but when it is separated from the small Guts, it shrinks and measures about two thirds less.

This Part, tho' one, yet by Reason of it's different Thickness, admits of two other Denominations. The thicker part, which is in the Midst of the small Guts, and knits them together, is from its Situation called *Mesenterium*, or μεσάραιον, because it is placed ἐν μέσῳ τῶν ἀραιῶν ἐντέρων: the other, which is the thinner, they call *Mesocolon*, μεσόκωλον, being seated in μέσα τῷ κόλῳ, in the midst of the Colon, to which, it is joined in its whole Length, save only in the Passage of the Colon under the Stomach; and in its lowest Border it adheres to the *Rectum*. The Mesentery is formed of two Common Membranes, which are, by many, supposed to come from the Duplicature of the *Peritonæum*, between these two, it has a third proper, (which was first discovered by Dr. *Wharton*, in dissecting a young Maid) this Membrane is thicker than the other, and is the Seat of the Glands and Vessels.

The Parts contained in the MESENTERY, are either *common* or *PROPER*. The *COMMON* are *Veins*, *Arteries*, *Nerves*, and the *Lymphæducts*,

ducts; the PROPER are the *Glands* and the *Venæ lacteæ*, of these we shall treat in the next Chapter, of the rest in this.

The *Veins* are called *Mesaraicæ*, and belong to the *Ramus mesentericus dexter & sinister*, which are Branches of the *Vena portæ*. I observed in a preceding Chapter upon the *Bowels*, that Authors were not agreed about the Uses of the *mesaraick* Veins, some contending that the Blood they contain, is received from the intestinal Arteries, to be carried back to the Liver and so to the Heart: others imagine, that they serve to convey a more immediate Recruit to the Body, by taking off "*Fistulis venosis excipientibus*," the Portion of the Chyle, which is redundant, and above the Quantity usually wanted to be derived to, and contained in, the *Venæ lacteæ*, which must take a larger Compass in reaching the Blood.

The Arteries of the Mesentery are two, the one *superior* the other *inferior*, both Branches of the *Arteria mesenterica*, which pass as the Veins do.

Dr. *Willis* says of the Origin of the Nerves hereunto pertaining, that as soon as the *intercostal Pair* is descended so low, as to be over-against the Bottom of the Stomach, it sends forth, on each Side, a large mesenterick Branch, each of which is again divided, and makes two *Plexuses* on each Side, in the Middle of which, is the greatest Plexus of all, which he compares to the Sun among the

Planets; from whence Twigs and numerous Fibres, are dispersed into all Quarters of the Mesentery, which accompanying the sanguiferous Vessels in their whole Process, climb over them and encompass them about. *Spigellius* affirms, that it derives some other Nerves, from those which spring from the *medulla spinalis*, between the first, second, third, and fourth *Vertebræ* of the Loins.

Besides these Vessels known to the Antients about an Hundred Years ago, another sort were discovered by *Thomas Bartholin*, a learned Dane, and by him called *Vasa lymphatica*. They are in Figure long and hollow like a Vein, but very small and knotty, having a Number of *Valves*, which permit the *Lympha*, or Water contained in them, to pass to the chyliferous Vessels, and to many of the *Veins*, but hinder it's return. They are of a pellucid and *crystallin* Colour like *Hyatides*; the Skin being very thin and transparent, which upon breaking, and letting out the *Lympha*, utterly disappears, their Number cannot be defined; and as to their Rise, *Bartholin* speaks uncertainly; but *Steno* and *Malpighius*, declare, that they always proceed from the Glands. With regard to their Insertion, those under the *Midriff* discharge their Liquor into the *receptaculum Chyli*; those in the *Thorax* immediately into the *thoracick Duct*; and those of the Neck, Arms, &c. into the *jugular Vein*. *Bartholin* thought, that they all discharged themselves
into

into these three Channels: but *Diemerbroeck* affirms, that they open also into the jugular and other Veins. *Frederick Ruysch* says, that all the Lympheducts of the Lungs, discharge themselves into the *Subclavian*, *Axillar*, and the *Jugular*. What this *Lympha* is, has been much disputed. *Bartholin* takes it to be the simple superfluous Serum of each Part, brought thither by the Arteries: *Glisson* contends, that it is a liquor condensed from the *Halitus* of the Blood, like dew, forced into these Vessels, and flowing back with the Vehicle of the Aliment brought from the Nerves. *Segerus* and *Sylvius* say, that it is the animal Spirits, or made of them, which after they are distributed into all Parts by the Nerves, are there partly consumed and dissipated, and partly condensed into this Water. *Diemerbroeck* quotes more Opinions beside these, but rejects them all, and establishes this as his own, *viz.* that it is a fermentaceous Liquor separated from the ferrous Part of the Blood in the conglobate Glands, yet not simple but impregnated with much fused and volatile Salt, and also some sulphureous Particles, which when it is conveyed to the *Vasa chyliifera*, makes the Chyle thinner, and apt to dilate more easily in the Heart; when to the Veins, it has the same Effect upon the Blood. This *Lympha* of what Sort soever it be, or destined for what Use, differs from the *Serum* of the Blood. For if a little of it be gathered in a Spoon, and suf-

ferred to stand a Time without setting it on the Fire, it will turn to a Jelly, which the *Serum* will not do. Thus much of the *Lymphæducts* and their *Lympha* in general; as to those, which belong particularly to the Mesentery, some only pass through it from the Liver and other Parts; but many have their Rise in it, and both the one and the other are emptied into the *Receptaculum Chyli*.

This Account of the *Lymphæducts*, and their Rise; in the *internal* Parts of the Body, did not satisfy succeeding Physicians, and has been, in Appearance, contradicted by a new *Hypothesis*, of which I shall speak in its Place; what was modestly advanced however by *Steno* the *Malpighi*, seems still to be very true. But the People, who came afterward did not chuse to improve upon their Foundation. As *Harvey* had proved that the *red* Veins received their Blood from the *Arteries*; so it being observed, says *Monro*, that the *Lymph* could only flow, on Account of their numerous Valves, from the smaller Branches of the *lymphatick* Vessels to their Trunk, *Anatomists* made no Question, but that in their *Origin*, they were similar to the *red* Veins. When therefore it came to be undeniably shewn by the *Microscope*, that a *red* Artery and correspondent Vein, made one continued reflected Tube; the same Thing by *Analogy*, and for other Reasons too, was supposed of the *valvular* LYMPHATICK Vessels. Experiments were repeated and confirmed

firmed by a Succession of the greatest Anatomists; *Nuck, C. Bartholin junior, Borrichius, Cowper, Lister, Bergerus, Morgagni, Waltherus &c*: from hence it was generally allowed to be unquestionably proved, “ that, “ the valvular *lymphatick* VEINS had their correspondent *lymphatick* ARTERIES, and that “ the Circulation of the *Lymph* was similar “ to that of the *red* Blood.” And from the Time of these Experiments there seemed to be an Emulation among *Anatomists*, who should best illustrate this Opinion by additional Arguments.

This Account of the valvular *Lymphatics* and their Use, it seems, was generally received and adhered to, till about the Year 1755. When Dr. *Alexander Monro junior*, Professor of *Medicine* and *Anatomy* in the University of *Edinburgh* communicated to his Friends a *Treatise*, the Substance of which was afterwards published at BERLIN, in the year 1757 wherein he supports, (as his Friend Dr. *Black* informs us) a new Opinion, with Respect to the *Origin*, and *Use* of the *lymphatic* Veins—to wit,—“ that they are a distinct System of “ Vessels, having no immediate Connection “ with the Arteries and Veins, but arising in “ small Branches from all the Cavities and “ Cells of the Body; into which *Fluids* are “ thrown, and that their Use is to absorb the “ whole, or the thinner Parts of these *Fluids*, “ and to restore them to the Mass or circula-

ting Humours," &c. (he does not say where, or how.)

Dr. *Hunter* now a Physician, late a celebrated *Surgeon* and *Anatomist* in *London*, disputes with Dr. *Monro* the *Merit* of this *Discovery*. Those, who have a Mind to peruse the Arguments on both Sides, may see them either in Dr. *Monro's* Pamphlet called *Observations Anatomical*, and *Physiological* &c. or in the *Critical Review*, Page 432, &c. &c. It is not my Business to settle a *Litigation* of this Sort, especially as the Reader has it in his Power to judge for himself. I can only observe, that upon many such Occasions, different People have had the Credit of being Inventors of the same Thing. *Etmuller* makes one *Paul Sarpà*, a *Venetian Monk*, a *Competitor* with *Harvey*, and *Corringius*, for the Honour of discovering the *Circulation* of the Blood. In my Opinion *Boerhaave* meant much the same Thing as Dr. *Monro*, and *Hunter*, in that Passage of his *Institutes* which I have quoted in Page 109, of this Treatise; what else can be "understood by" *Lymphæ tenuissimæ, aquosæ primo, dein hinc Lymphæ sensim crassiori*? &c. Pag. 221. At least the same *physical Use* is in great Measure to be collected from *Boerhaave's* Observation namely, that any Poison lurking in or about the Skin, or *cellular Membrane* &c. is by these Channels communicated to the *Mass* of Blood:

I allow the *inhalant Vessels*, which he mentions,

tions, here to be those pertaining to the *external* Parts of the Body: whether he imagined, that the internal *Lymphaticks* had all the same Use, I will not pretend to infer from this Passage, perhaps he thought the contrary: But beside *Boerhaave*, *Dr. Gibson* an experienced Physician of our own Nation seems to make some of the *internal* Lymphaticks answer the Use of *Resorbents*, as he long since declared, that the *Lungs*, contained *inhalant* Vessels ("not *Veins*") which in the Cure of an *Empyema* were found to imbibe, and throw up by Vomiting the bitter Injections squirted into the *Thorax*. *Dr. Willis*, who was prior in Time to both these, gives us, in a few Words, something that approaches nearer to a regular System, agreeable to the Principles of the Physicians of the Age he lived in: he conjectures, that the Juice wherewith the Brain and nervous Parts are irrigated, is carried from the Blood, into the *Genus nervosum*, and thence by the *lymphatick* Vessels back to the Blood. from these Passages I think it is pretty clear, that these more antient *Physicians* were all of Opinion, that some of the *Lymphaticks* at least, served the Purpose of *Resorbents*. Whether these *Moderns* have made out more than this, or whether the *Theory* of some Distempers can be better explained upon this new *Hypothesis*, the Learned are to judge. I have only to observe in the last Place, as to the new Name, which these Gentlemen seem by Consent to impose upon the *Lymphaticks*, on Account of the new Use they ascribe to them,

I say

I say I cannot but observe, that, it does not appear, to answer their Purpose. Since the *Lacteals*, or any other Set of Pipes, which drain off Moisture from the *Cavities*, or greater *Channels*, have as good a Title to be called *Absorbent*, as these: they intended no Doubt to signify, that the *Lymphatick*, were employed to draw in the Lymph and carry it back towards the Heart, to express this office then, they should found a Name for them which might signify not only the Act of *Inbalation*, but also the Direction of the Fluid they conveyed, wherein the Word *Resorbent* would have served them as well as *Absorbent* if they could not have found a better to return.

The *Glands* of the *Mesentery*, according to *Boerhaave*, are very soft; they are fixed in its proper Membrane, but covered on each Side by the common Membranes, and beset with Fat; according to him, the Chyle does not secrete any Thing at these Glands, but is rather there diluted. “*Quod magis Clarefcit,*” (says he) “*fi cogitas Glandulas has cavernofas*” “*Arteriis fufum Deorfum diftributis, fingulari*” “*omnino hic Reptatu, non in glomeram Aëlis,*” “*Nerviſque irrigari plurimis, atque admittere*” “*Lympham multorum in Abdomine viſcerum,*” “*quæ & ibi intrans Humores magis Diluit*”—*HALLER* adds of this Water to the ſame Purpose—“*Hæc enim aqua ex ſua Indole Fluida eſt,*” “*atque Fluidior per putredinis Initium, Con-*” “*temperat adeo Lentorem olei omentalis, Meſen-*
terici,

“ *terici, & a Coagulatione servat, &c.*” (Halleri Phys. pag. 424.) Boerhaave says moreover, “ *Forte & fines ultimi Arteriosi, in Cavernulas harum Glandularum exhalantes, immittunt Tenuissimum suum Humorem, ut ex Arteriis Murcurium ire in Lactea ait Cowperus,*” — (Boerhaave Institut. pag. 82.) These GLANDS are in Number very uncertain, in Man they are fewer than in other Creatures. The biggest by much, is at the Rise or Center of the Mesentery, (called by *Afellius, Pancreas*) into which all the *Venæ lacteæ* are inserted. Of it's use, and likewise of the lesser ones, we shall speak in the next Chapter, when we come to treat of the Passage of the Lacteals. We shall only observe here, that when these Glands grow schirrous, or are any Ways obstructed, so that the Chyle cannot transcolate through them, there follows a *fluxus Celiacus*, or *Chylosus*, which continuing, there ensues an *Atrophy*, and the Party dies under the Appearance of a Consumption.

The Fat of the *Mesentery* which is stuffed between it's Membranes, tho' it happen naturally to it, is not, strictly speaking, a *proper* Part. For not to mention that in Dogs, Cats, and such like Animals, this Part is very thin and transparent; even in the human Embryo it is without Fat, and in Men, who are lean, there is but little, tho' in such as are of a corpulent Habit it is heaped up to so great a Thickness.

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The Diseases incident to this Part, are reckoned by Dr. *Wharton* to be such as these; *Intemperies*, Straitness, or Obstruction, Tumors of whatsoever Kind (*Schirri*, *Scrophulæ*, *Strumæ*) Inflammations, Abscesses, Ulcers, and Tone vitiated: of all which, the Reader, who desires fuller Information, may be satisfied by the said learned Author, in his *Adenographia*, Cap. 11.



C H A P. XIX.

Of the Venæ lacteæ, receptaculum Chyli, and the Ductus Chyliferus Thoracicus.

THE *Venæ lacteæ* or *milky Veins*, so called from the white Colour of the CHYLE contained in them, were not discovered to be such till the Year 1622, when *Caspar Asellius* found them out by dissecting a living Dog, which had been first well fed. But since his Time, many others have made more accurate Observations upon them. They are slender pellucid Vessels, having only a single Coat, and are dispersed in an infinite Number through the *Mesentery*. They spring out of the *Intestines*, into the inmost Coat of which their Mouths are inserted; and being hid under a spongy Kind of *Mucus*, receive the *Chyle* which

which is forced into them by the Pressure of the Guts. Presently after their Rise, they tend to the nearest Part of the *Mesentery*, and then to the nearest Glandule of the same. But in their Passage, many little Branches meeting sometimes grow into one great Trunk, before they insinuate themselves into the Gland to which they were directed. Though in their very Entrance into the Glands, or a little before, this Trunk separates again into new Branches more numerous and smaller than the other, which are obliterated in the very Substance of the Gland. Out of the Gland there spring again new capillary Veins, called by *Boerhaave*, *Lactææ secundi Generis*, which by and by meeting together make one Trunk as before, and being carried towards the Beginning of the *Mesentery*, in their passage join themselves to others of the same Kind, and so grow larger and larger, till at last many of them enter into the great or middle Gland of the *Mesentery*, (called improperly the *Pancreas*, or for Distinction *Pancreas Asellii*,) in the same Manner as they entered the smaller, while some pass over its superficies, and soon after all empty themselves into the *common Receptacle of the Chyle*, which lies under the said Gland, those that were inserted into it rising out of it again.

Bartholin says, that behind the *great Gland*, there are three others smaller springing out of it, which he calls *Lumbares*, into which the *Lac-*
teals

teals are inserted, but is of Opinion with Dr. *Wharton* that they pass to the *receptaculum*.

This common Receptacle is called *receptaculum Chyli Pequetianum*, from *Pequet*, who above 90 years ago first found out both it and the *ductus Thoracicus*, which is only a Continuation of the Receptacle. It might as well be called *receptaculum Lymphæ*; for the Lympha not only passes with the Chyle, but after this is all distributed, the Lympha still continues to glide into it, and to ascend by the *ductus chyloferus Thoracicus*, which, for the same Reason might as well be called *Lymphaticus*. This RECEPTACLE is seated under the *Cæliack Artery* and the *Emulgents* at the *Vertebræ* of the Loins, whence there springs a DUCT, which presently enters the *Diaphragm*, with the *great Artery*, where being now entered the *Thorax*, it begins to be called *ductus Thoracicus*. And now, though it be passed out of the Abdomen (of the Contents whereof we are here treating) yet we will trace it through the *middle Ventricle* to the HEART, whither it conveys its Liquor, for the same Reason, that being to speak of the STOMACH, we took in the GULLET into the Description, as being an *Appendage* of the same, tho' passing thro' another Region.

The Size of the *receptaculum Chyli*, according to some Anatomists, is two thirds of an Inch over. It is formed by the Union of three Tubes, one from under the *Aorta*, the

SECOND from the *Interstice* of the *Aorta* and *Cava*, the *third* from under the *Emulgents* of the right Side. It is not always a *Cistern* according to *Haller* “ *Est ubi duo tresve Ductus,*
“ *etiam minores, & angusti, Loco hujusmodi*
“ *Disternæ adsunt. Frequentior tamen ea est,*
“ *& Compressa a Diaphragmate, ab aorta Eli-*
“ *sâ, tanto celerius Chylum promovet, quanto*
“ *Flumen latius Ductu habet, in quod se exone-*
“ *ret.*” *Tit Ductus thoracicut*

As for the *Passage* of the *DUCT* having past the *Midrif*, it marches farther upward under the great Artery, till about the fifth or sixth *Vertebra* of the *Thorax*, where it turns a little aside from under the great Artery to the left, Hand, and so below the *intercostal* Arteries and Veins ; under the *Plura* and the Gland *Thymus*, it ascends to the left *subclavian* Vein, into whose *lower Side* it opens, just where the left *jugular* Vein enters it on the upper Side, so that their Mouths face one another. It enters not into this Vein with any large Orifice, but *six* or *seven* little ones, which lie all together covered in the interior Cavity of the *Subclavia* by one broad *Valve*, looking towards the *Cava* from the Shoulder, whereby there is granted a free *Passage* to the Chyle and *lympa* out of the Duct into the *subclavia*, but the Return, as likewise that of the Blood, with it is prevented. *Boerhaave* in this Place, speaks of *two similunar Valves*, which he describes to be of the Sort called
Conniventes.

Conniventes. This *Duct* ending thus in the *subclavian Vein*, the *CHYLE*, which it conveys into it, passes with the Blood descending by the *Cava* into the *right Ventricle* of the *HEART*. The Structure of the *Duct* is, in some Respects various; the Channel or Channels have always *Valves*, after the Manner of the *Lacteals* in the *Mesentery*, to hinder the ascending Chyle and *Lympha* from returning down again; but the Channel, tho' generally so, is not always *one* throughout, for it frequently divides and makes an Island, and in the upper Parts especially, unites again. It retains all the Way a cylindrical Form, and receives the *lymphatick* Vessels of the *Ventricle*, the *Gullet* and the *Lungs* coming to it, through *conglobate Glands*, of which there are many surrounding it. There are some Variations in the Manner of *Insertion*; for at its *Curvature*, near the Entrance, it sometimes divides, but joins again, before the Entrance. It is very rare to see this *Fissure* of the Channel carried to both the *Subclavians*; and more rare to find a Branch of it entering the *Vena sine Pari*. *Haller* says, that just at it's *Insertion* it receives transversely a great *Lymphatick* from the Limb above, and one or more descending from the Head. The Reader may see a distinct Representation of *Receptaculum Chyli*, and of the *Lymphaticks* and *Lacteals*, as entering the same: and likewise of the *Ductus Thoracicus*, and it's Passage

sage between the *Azygos* and the *Aorta* to it's Insertion, in the seventh Edition of *Cbifelden's Anatomy*, Plate 26, Page 254.

The CHYLE, being thus mixed with the Blood, does not immediately lay aside its Nature. An Argument of this, says *Haller* we have in the MILK that rises from it. Yet, says, he *five* hours after a meal and more, even to the *twelfth* (in all which time a Woman can give Milk) being carried throughout the human Body eighty thousand times, cherished by the Heat of that Body, and mixed with the *human* Juices, it is so changed, that some of it is left as FAT in the *tela Cellulosa*, while some again should seem to take the Figure of *red Globules*, the *gelatinous* Part making the *Serum* of the Blood, the *watry* going off by *Urine* and *Perspiration*, or else serving to dilute and *thin the Mass* already collected. When the Time of Digestion is over, the *lacteal* Vessels drink up the *Water* from the *Intestines*, and appear *transparent*, the *thoracick Duct* particularly receives the Moisture of the *Abdomen*, and almost of every Part of the Body, in order to Return it to the Blood.

In the Room of the *Milk* in the *chyliferous* Vessels of *dying* Animals, there sometimes succeeds a *pellucid* Liquor, as in different Parts of an Intestine there are discovered sometimes a white and sometimes a clearer Fluid, which yet are of a *similar* Substance. So that it is not a *property* of the *lacteal* Vessels to carry

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the CHYLE alone, since they may be *Lymphatics* in their turn.

And thus we have advanced thro' what may be called the *first STAGE* of *Physiology*, or *Animal Oeconomy*; and given a *Description* of the PARTS and the *Uses* of the PARTS principally concerned, in *producing*, *perfecting* and *Conveying* the CHYLE into the Mass of BLOOD.



C H A P. XX.

Of the Place of the Chyle, as an Humour of the Body.

HAVING thus taken a full View of the *Origin*, and *Composition* of the *Chyle*, and traced it thro' its intricate Passages to it's Admission into the BLOOD, the immediate Connection between these Humours, if we follow the *Order* of NATURE will unavoidably make the BLOOD the next Subject of our Consideration: and I should immediately proceed to give an Account of its Appearances, Qualities, and component Parts, had not a Diversity of Opinions, concerning the *Chyle*, as a *Humour* of the Body, given me a little Interruption. Among the *Antients*, some will not allow the *Chyle* to be an *Humour*: And yet it has all the *Properties*, which they assign,

as

as requisite to deserve the Name. “ *Humorem appello* (says JACCHÆUS) *non Qualitatem* “ *Primam Siccitati adversantem, quæ, ὑπόρρη,* “ *dicitur, sed Corpus mistum.*” Well! the CHYLE is a *mixed Body*—Again,—“ *proprie* “ *Humor competit succis alimentariis,*” &c. The CHYLE likewise nourishes, and yet he says, “ *Chylus, Fæces, Lac, Semen, Sudor, Urina,* “ *inter humores non numerantur.*” Pag. 49.

The Moderns do not deny the CHYLE the Name of an *Humour*, tho’ they are not so well agreed about its proper Place. The HUMOURS are generally divided by them, either into *primary*, or *secondary*; or into *alimentary*, or *excrementitious*.

Reckoning the Humours as they arise from the *Aliments*, the Chyle will be *primary* in *point of Time* to all the rest; and again considering it, as affording *Matter* for *Supplies* of all Sorts, it will stand as *Cause* to an *Effect* in *Relation* to any Thing, which is *generated* from it: therefore say some, on this account likewise, it will be *primary* to the Blood.

This may be very true in respect to the *adventitious* Blood, which is daily *recruiting*.

But on the other hand, it has been observed, that the *Blood*, at least a *Part* of it, is so far a *primary Humour*, as to be the very *Principle* of *Animal Being*, and that it shews itself antecedent not only to any other *Humour*, but even to the *Formation* of the *Parts*:

HARVEY mentions a *Punctum saliens*, or *beating Speck* of the *Blood*, which may be discerned in the *Embryo*, before the least *Lineaments* of the *Heart* appear.

And KEIL imagines, that some of the original *parental Blood* continues with the *Animal*, thro' every *Stage of being*, to the very last.

The Difficulty then created by this *Opposition* of Opinions may be resolved to the Satisfaction of both Parties, by observing that the *Blood* is of two Sorts, *native* and *adventitious*; that the *adventitious* is indeed *secondary* to the *Chyle*, as being made from it: but that the *native* is *primary* to it, and every other Humour.

This being premised, by way of Correction, I shall give the Reader a View of the other Humours according to the *Scheme of Dr. MARTIN LISTER*, in which, I imagine, the judicious may make Improvements, tho' the *Original* is not without its Use.

HUMOURS	{ Primary. (This should be by Nature.)	
	{ The BLOOD properly so called.	
	{ It's SERUM, or Lymph.	
	{ From Concoction,	
	{ The CHYLE.	
	{ From Secretion,	
	{ The most useful,	
	{ The MIEK,	
	{ HUMOR GENITALIS,	
	{ Less useful,	
		{ i. e. nutritious, according to
		{ others.
		{ i. e. partly excrementitious.
{	{ The URINE,	
	{ The SWEAT,	
	{ The PHLEGM,	
	{ The BILE.	

This

This Scheme is in other Respects *defective*. He does not say, which are the *secondary Humours*, of which Sort however is the *Blood* from the *Chyle*; and all the Humours formed by *Secretion* which are so many successive Refinements upon the *Matter* received from the *Aliments*, and belong either to the second or third Stages of PHYSIOLOGY, and others to those Degrees, which are still more remote.

Of the HUMOURS formed by *Secretion*, the same Author says they arise,

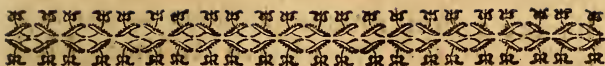
Either from the BLOOD properly so called, as
 The BILE;
 from NEW CHYLE that is less purged, as
 MILK;
 from NEW CHYLE, but more elaborated, as
 URINE,
 SWEAT;
 from LYMPH that has undergone *Purgation*,
 PITUITA, or PHLEGM;
 from LYMPH most purged and *old*,
 HUMOR GRNITALIS.

It would have been of Service to this Author to have taken in the other Division of the Humours, which distinguishes them into *nutritive* and *excrementitious*. Amongst the nutritive Dr. WILLIS reckons the nutritious Juice from the Blood, which they call *the Chime*. Dr. GLISSON says that the Blood is dissimilar to the Nourishment of several Parts and rather preys upon them, he supposes this

nutritious Juice to be conveyed by the *Nerves* and elaborated in the *Brain*.

Other Physicians distinguish the Humours by the Place they occupy, as the Water of the *Intestines*, the Water of the *Joints*: or by their *Species*, *Quality*, or *Consistence*, as *gelatinous aqueous*, &c.

The Reason of my speaking of them here *in general*, was to shew, that the *Chyle* was an *Humour* of the Body, and *moreover* the *Precedence* it held among the other Humours; for any Thing that is *peculiar* to any of these, it is not to be expected here, a minute Description being reserved for each, as they shall arise, in their proper Place.



PHYSIOLOGIÆ *humanæ*, sive *Propriæ*
STADIUM SECUNDUM;

O R

THE SECOND STAGE

O F

HUMAN, or PROPER
PHYSIOLOGY.



CHAP. XXI.

*Observations upon the different Appearances or
Colours of Human Blood, &c.*

IT seems evident, from the foregoing Chap-
ters, that the *Principles* of the BLOOD are
in the CHYLE, as again, the *Principles* of the
Chyle are in the FOOD, but not in that ALONE ;
“ *Chylus male habetur solius cibi et potûs sobo-*
“ *les : est enim humor partem maximam con-*
“ *stans salivâ, muco tenui oris, liquore duplici*
“ *œsophagi, et ventriculi, bile cystica, bile he-*
“ *patica, lymphâ pancreatis, humore intestinali*
“ *lymphatico, humore intestinali Peyeriano, ner-*

N 4

“ vorum

“ vorum forte effuso copioso subtilissimoque
 “ liquore a tam innumerabilibus *nervis* sup-
 “ peditato.” &c. (Boerhaave Institut. Med.
 p. 72.) This being the Origin of the *Synthesis*,
 or Composition, both of *Chyle* and *Blood*, let
 us first consider the different Appearances of
 the latter, and then attend to the *Analysis* of
 its component Parts, and hear what accounts
 the Learned gives us of its Composition and
 Texture.

The first thing which offers itself to our
 Observation in the Blood, is it's *red* COLOUR,
 whereby it is distinguished from the new mixed
 Chyle ; which, as has been observed before,
 retains it's Whiteness for some Hours, tho' it
 is immediately conveyed with the Blood, by
 the *Vena cava*, into the right Ventricle of the
 Heart, which receives it in its *Diaστοle*, or Re-
 laxation, from whence, in the *Systole*, or Con-
 traction, it is driven into the Lungs, then in-
 to the left Ventricle of the Heart ; and thence,
 by the *Aorta* thro' the *Arteries* of the whole
 Body, returning again by the *Veins* to the
 Heart ; where, after many Circulations, it
 undergoes so little change, that *Etmuller* ob-
 serves, “ *Imo ipsæ sanguinis fibræ, rubicundæ*
 “ *apparentes, reverà albicant, & chyli videntur*
 “ *proles.*” Which is the more probable, not
 only because of the milky Appearance that
 swims upon the coagulated Blood, though
 taken from a Person five Hours after eating ;
 but also, because it is the CHYLE but little al-
 tered

tered, that is separated in the *Placenta uteri*, for the Nourishment of the *Fætus*, and likewise in the BREAST, for the *Infant* to suck. It is to be observed however, tho' the Changes be thus gradual, yet, every time that the new infused CHYLE passes through the Heart with the BLOOD, the Particles of the one are in its Ventricles more intimately mixed with those of the other ; and the vital Spirit, or other *active* Principles of the Blood working upon the Chyle, which, being full of Salt, Sulphur, and Spirit, these, as soon as its *Compages* are loosened by Fermentation, having obtained their Liberty, associate with such *Parts* of the BLOOD as are most suited to their own Nature. Now whether this Alteration which happens to the Chyle, especially in the Heart, should be said to proceed from *Fermentation* or *Accension*, or what other Action or Cause, is a thing not yet agreed upon, being a Question full of Difficulty. But it seems to be from *Fermentation*, by Reason of the considerable Heat observable in the arterial Blood ; and if there be any thing of *Accension*, that seems to proceed not so much from any Cause inherent either in the BLOOD or CHYLE, nor to be effected so much in the *Heart* and *Arteries*, as in the *Lungs*, whilst the Blood passes through their *Parenchyma* out of the *Vena arteriosa* into the *Arteria venosa*, and is *inspirited* or impregnated with nitrous *Air*, drawn into them by Inspiration ; which will appear from what I have

have to say upon the *red Colour* of the Blood, which some attribute to the Heat or Action of the Heart; others to the mixture of Salt, and *subacid* Juices with *sulphureous*. As the Oil of *vitriol*, poured upon Conserve of Roses, or any thing of a palish red, that contains a mixture of Sulphur, turns it to the deepest Colour. We will not spend Time, to shew in how many respects this Similitude falls short of explaining the Reason of the *Phænomenon*, but shall rather enquire into the Cause of some of the most remarkable Varieties in the Blood's Appearance; and first for the Difference of *Colour* between the *venal* and *arterial* Blood.

Every one knows, that Blood let out of a Vein, and received into a Porringer, tho' it be of a florid scarlet Colour on it's Surface, yet, under that, the coagulated Part, from the Superficies to the Bottom, is of a *dark red* colour: and of such a Colour it appears, as it streams out of the Orifice of the Vein. But if an *Artery* be cut, the Stream then looks of a far brighter Colour, like the Superficies of the *venal* Blood. Now the *arterial* Blood receives not this florid Colour in the *Heart*, but in the *Lungs*. For if it be received in the Heart, then might the right *Ventricle* be supposed to give it as well as the left: but that it does not so, is clear from this Experiment of Dr. *Lower's*. If you open the *vena arteriosa*, (by some called the pulmonary Artery) which receives the Blood from the right Ventricle, the
Blood

Blood there differs nothing in Colour from the venal ; it's curdled part looking to the full as black. But if one open the *Arteria venosa*, (by some called the pulmonary Vein) as it is entering the left Ventricle, it has the perfect Colour of arterial Blood ; which, as it shews that it owes not that Colour to the left Ventricle any more than the right (because it is not yet arrived at the left) so it plainly proves that it receives this Alteration of Colour from the Lungs, where the nitrous Air being diffused thro' all the Particles of the Blood, is intimately mixed with, and, if you will, accends it : for if there be in Animals any such thing as the *Flamma vitalis*, or vital Flame properly so called ; tho' the Blood be to that Flame, instead of the Oil or other Matter whereupon it feeds, yet it oweth the Continuance of it's burning to the Air, without the perpetual Inspiration of which the Animal instantly dies, as a Candle is presently extinguished, if put into a close Place, where the Air has no Access, or where, by some Engine, it is sucked away. But this by the way ; for notwithstanding the Plausibleness of the Opinion, the Author, whom I have now before me, does not think that this Alteration of the Colour of the Blood in the Lungs is a sufficient Argument to prove the Being of any such vital Flame ; because the arterial Blood being extravasated, retains it's florid Colour ; when, if there ever was any Accension, the Flame must have

have been extinguished. And to shew that this scarlet Dye on the Surface of the venous Blood is owing to the Action of the Air, he says, if one turn the congealed Blood in a Porringer upside down, the lower part, which, at the turning up, was blackish, will in a little time, grow red as the other.

If this account be true, and the *Action* of the AIR be the Cause that produces the rosy Colour of the Blood, is it not a Proof that the *buff coloured* Surface, which suffers no Change from this Action, must contain something heterogeneous to the Blood, tho' blended with it by Circulation? Its Figure is like a tough and yellow Film, or Membrane; and it's Edges, when lifted above the *Serum*, have a mixed Resemblance of *Horn* and *Fesh*. If it be the *Air* which gives this Matter this Appearance (for at the first Emission of the Fluid it is not distinguishable from the Mass) it would be worth a Physician's while to be informed, wherein this Matter, which, by the Effect of the Air, becomes so different in *Appearance*, is in it's *Nature* likewise, distinct from BLOOD.

C H A P. XXII.

Of the Component Parts, or Principles of the Human Blood.

THE Methods of *analysing* this COLLUVIES of *Humours* and explaining its *Composition*, have varied, as Men have differed in *Times*, and *Opinions*. The first REFORMERS of Physick among the *Moderns*, made use of *Chymistry* to assist them in their Discoveries, and therefore as to the *Principles*, of which the *Mass* of Blood consists in its mixed State, and what *Proportion* they have in it, they reject the Opinion of the *Antients*, at least do not usually consider it as a Mixture of the *four Humours*, i. e. of *Blood*, or the red *Fluid*, *Flegm*, *Choler*, and *Melancholy*; or hold, that according to the Predominancy of this or that Humour, the divers Temperaments are formed; or that by Reason of their Fermentations and Exorbitancies, all Diseases in a manner arise: Hence it is that now a Days, this Opinion has not been so generally used for solving the Phænomena of Diseases, since the *Circulation* of the Blood, and its other *Affect-ions*, before Unknown, have been brought to Light: and since those very *Humours* consist of other *Principles*, viz. CHOLER of *Salt*, and *Sulphur*, with a Mixture of *Spirit* and *Water*, and MELANCHOLLY of the same, with
an

an Addition of *Earth*; and since the Blood is immediately composed of these *Principles*, and resolved into them, these Writers chose rather to make use of the known Principles, which prevailed amongst the *Chymists* of their Times for explaining the *Nature* and *Affections* of the Blood, and supposed that there are in it, as in all other Liquors apt to ferment, a *great deal* of WATER and SPIRIT, a *small Proportion* of SALT, and SULPHUR, and somewhat of EARTH; upon these *Principles* they endeavoured in the manner following to account for its *Consistency*, *Properties*, and *Appearance*.

The SPIRITS then, which have the first Place in their System, are the most subtle and volatile part of the Blood: their Particles being always expanded, and endeavouring to fly away, exagitate the grosser Corpuscles of the rest, in which they are Involved, and keep them always in a *Fermentation*; by the Effervescence, and even Expansion of these in the Vessels, the Liquor of the Blood continually boils, and the rest of the Principles are kept in an exact Mixture, and orderly Motion. If any thing that is *heterogeneous*, or unapt for Mixture, be admitted, presently the Spirits being troubled in their Motion, exagitate the Mass, and make it boil vehemently, till that which was extraneous and immiscible with it, be either subdued, reduced, or driven out.

2. From

2. From the Dissolution of SULPHUR in the *Blood*, it is likely, that the *ruddy* Tincture of the same arises. For sulphureous Bodies, above all others, give the highest saturated Redness to a solving *Menstruum*. And if at any time, by means of too much Crudity, the Sulphur is not dissolved, the Blood becomes pale and watery, and will scarce give a red Colour to Linnen. The Mass of Blood impregnated with Sulphur, together with Spirits, is very fermentative, and when the sulphureous Part is raised, and abounds too much in the Blood, it perverts its *Crafts* from the due State; so that thereby being depraved, or rendered bilious, it does not rightly concoct the * *nutritive* Juice; or being wholly inflamed, falls into Heats and Burnings, such as arise in a continual Fever. For the *Sulphur* being too much exalted, and growing more turgid than it ought, raises mighty Effervescences: hence it is, that those, whose Blood is plentifully impregnated with Sulphur, are very obnoxious to *Fevers*.

3. Even before the *Operation* of the Fire, we discover SALT in the Blood by the Taste, which is there highly volatilized by *Circulation*; and if at any Time, by Reason of an *Indigestion*, these *saline* Particles are not duly exalted, but continue crude, and for the greatest Part fixed, the whole becomes thick and unapt for Circulation, so that *Obstructions*

* The *Chime* beforementioned.

are engendered in the *Viscera* and solid Parts, and *serous* Crudities every where heaped together: but if the SPIRIT being depressed and fainting, the SALT is exalted too much, and comes to a flowing, then an *acetous* and *austere* Disposition is brought upon the Blood, such as is observed in *Scorbutical* persons, or those, who are troubled with a *quartan* Ague. Also from the SALT in this manner variously coagulated, the *Gout*, *Kings-evil*, *Nephritis*, *Leprosy*, and a great many chronick Diseases, have been supposed to arise. When the Salt is exalted in a due Measure, the *saline* Particles restrain the wild Efforts of the *Spirits*, and especially of the *Sulphur*; wherefore those who have the Blood well saturated with a *volatile* SALT, are more free from Fevers, as those who are often blooded, I suppose, by keeping these Salts in a *crude* unconcocted State, are generally more subject to the same.

4. By the EARTHY PARTICLES in the Blood, its too great Volatilization is stayed and its over quick Accension is hindered. Moreover, from the terrestrial Particles of the Blood and nutritive Juice, the Bulk and Increase is administered to the Body.

5. On the WATRY PART of the Blood it's Fluidity depends. For hereby its Stagnation is hindred, and the Blood is circulated in the Veins without growing thick. Also its too great Conflagration and Adustion is qualified, and its Heat allayed.

What

What has been here advanced concerning the *Principles* of the Blood, will appear more evident, if it be considered according to its *sensible* Particles, and compared with the *Liquors* which are frequently in Use amongst us, some of which have a great *Analogy* with the Blood, such as WINE and MILK. For Blood, as to its ways of *Fermentation* and Effervescence, is most aptly compared to WINE; as again, for its *Consistency*, *Coagulation*, and *Separation* of the Parts from each other, it bears a great Resemblance to MILK.

First, therefore, we may observe concerning WINE, that as long as it is included in a Vessel, its subtle and spirituous Parts continually exagitate and refringe the more gross, and render them apt for an exact Mixture; that which is heterogeneous and unapt to be subdued is severed by Effervescence: mean while the depurated Liquor, gently fermenting, is in perpetual Motion, whereby all the Parts expand themselves every Way, and pass by a constant *Circumgyration* from the Top to the Bottom, and again from the Bottom to the Top; by the particular Fretting and Refraction a great many Effluvia part from the Liquor, which, if they are confined by a Vessel close stopped, the Liquor ferments too much, and often makes the Vessel fly in Pieces. In like manner the Blood within the Veins is prest on by a constant Circulation: the *vital* SPIRIT subtilizes, refringes, and
O presently

presently subdues the grosser Particles: drives forth that, which is *heterogeneous* and *immiscible*; mean while from the *Refraction*; and working of the *Parts* and *Corpuscles*. the *Effluvia* of Heat constantly fly off, and evaporate by the PORES; upon the Closing of which, and *Transpiration* being hindered, presently, by Reason of the too great Effervescence of the Blood, there ensues a FEVER.

Secondly, we may observe concerning WINES, that they grow turgid, if any thing which is *extraneous*, and of a fermentative Nature, be mixed with them; nay, that they are now and then troubled more than usually of their own Accord. For where, by a long Digestion, the sulphureous Part of the Wine is exalted too much, it falls into an *Effervescence* greater than it ought, and unless presently appeased, perverts the *Crisis* of the Liquor by its Turgescency; which seems to be altogether the same thing with the *feverish* Effervescence raised in the BLOOD, which is usually Introduced by *Causes* the same in KIND.

The *third* Observation or Comparison made of the Blood with Wine is this; Wines (as many other Liquors) have their times of Crudity, Maturation and Decay. The same Thing is remarkable in the Blood; concerning which, see Dr. *Willis* more at large; and so far of the Comparison of the Blood to Wine.

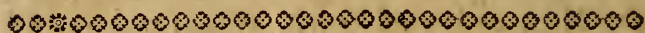
As for its Similitude to Milk, it chiefly consists in the Diversity of its Parts, and their
Separation

Separation from each other, which is most apparently seen, when it is let out of the Veins, and grows cold in a Vessel. For when the Heat and vital Spirit, which preserve all in a Mixture, are fled away, the remaining Parts are loosened from each other, and there is made a Separation of the thin from the thick; of the *serum* from the fibrous Blood.

Having said thus much of the Composition and Qualities of the Blood, it belongs to this System to observe, that the Nutritive, or Nutritious Juice, just mentioned above, which is supplied from the Blood, and severed from its Mass for the Nutrition of the solid Parts, sometimes, by Reason of its Depravation and irregular Motion, causes many Symptoms in Fevers. If my Memory does not deceive me, some capital Physicians make it one Seat of Fevers, and with very good Reason, if, by this nutritive Juice, be meant the animal Spirits, of which there is a most ingenious and rational Account in Dr. *Glisson's Anatomia Hepatis*, to whose *Hypothesis* this Author seems to allude, tho' not in all Respects to agree, when he says, of this *nutritive* Juice, that, by a certain Circulation, after it has past the nervous Parts, the Remains of it being effete and poor, are sent back by the *lymphatick* Vessels to the Blood, &c.

But these Things belonging (according to my Division of the Subject) to another Stage

of the *animal Oeconomy*, the Reader will see them in their proper Places.



C H A P. XXIII.

Containing later Observations upon the foregoing Subject, divided into Chymical, Microscopical, and Natural.

SUCH were the Opinions of the Physicians, who flourished about the Middle of the last Century, concerning the Nature and Texture of the Blood, and such the Manner in which they accounted for its different Appearances. Those who succeeded have added something to their Observations, but not much. Their Experiments have been either *chymical, microscopical* or *natural*. The *chymical* Examiners confirm the former Accounts of the Principles of the Blood, and mention some Properties, which seem to have passed unobserved before. Concerning the Spirits, on *Halitus*, before-mentioned, the later Writers vary but little from the former. " *Hydrostatica Pericula ostendunt,*" says Haller, " *in sanguine primò Volatile aliquid, et halituum esse, quod in ipso aere continuò ex sanguine Avolet, cum odore quodam inter Fætorem Urinæ, & sudoris odorem Medio. Id vasis idoneis Receptum, aquosum Apparet,* cum

cum levi alcalinæ Indolis quasi Tinctura." With
 Regard to the other Principles, he observes,
 —“ *Terram inesse et Nutritio demonstrat et*
 “ *Chemica Analysis, quæ in fluidioribus Partibus,*
 “ *et oleo Maxime mista latet. Ferrum magna*
 “ *satis copia inesse in Calcinato cruore nuperri-*
 “ *mis Experimentis ostensum est. Denique aer*
 “ *non Elasticus Sanguini mistus est, quem putre-*
 “ *do in sanguine et sero demonstrat, et Aeris*
 “ *ambeuntis Extractio, non ideo Globuli aeræ*
 “ *bullæ sunt, cum specificè sero Graviiores sint.*”

The chymical Experiments which he adds are these that follow: that Blood just taken from the Body, and free from Putrefaction, being exposed to a gentle Heat, will distill a quantity of Water, amounting to $\frac{5}{8}$ Parts of the Blood, and upwards, which Water is almost insipid, accompanied with a Portion of foetid Oil, and the more so, as it comes out the latter. This oily Substance is, no doubt, the first Appearance of what the Physicians of the last Century, called the SULPHUR, which these very modern Authors, now so much in vogue, affectedly pass in Silence; and yet, what other name can they reasonably give it? A stronger Degree, or Repetition of Fire has pretty much the same Effect upon Wine. GEOFFERY observes, that the Remains of it, after the first Process, being put into another Vessel or Retort, and exposed to a more Intense Heat, there will be a small Portion of Phlegm, which comes over first, then an acid Water,

and next a *fat oily* Substance, called SULPHUR. But to return: after the Appearance of the fœtid Oils upon the first Distillation of the Blood, they tell you, that the Residue, being subjected to a stronger Heat, affords various Sorts of alcalious Liquors; the first of which being of a red Colour, sharp and fœtid, is called the *Spirit of Blood*, and is composed of a volatile SALT, dissolved in WATER, and amounts to about the fiftieth Part of the whole Mass,

Both before the Appearance of the Oil, and after, there is produced a dry volatile Salt, which adheres to the Neck of the Glass in Flakes and Ramifications. Its Quantity is but small, about an Eightieth Part.

Lastly, they tell you, which is only the Effect of a greater Degree of Fire, that there comes out a Liquor gradually thicker, gradually heavier, which is at first of a yellow Colour, then black, tenacious as PITCH, sharp, and *inflammable*, known by the Name of *Oil of Blood*, in Quantity much the same as the Spirit; that is, about the fiftieth Part of the Whole.

If the Reader will compare the Observation I made above, upon the first Appearance of these Oils, with what follows, I believe he will be inclin'd to think with me, that this oily Substance, from first to last, is what former Physicians called the SULPHUR of the Blood: for these very Moderns themselves declare,

lare, that the porous Cinder, which is left in the Bottom of the Vessel, is inflammable, and burns away upon taking Fire, leaving an Ash. These Ashes upon making a Lixivium, they say, produce a Salt, which is a mixture of the *Alcaline fixed*, and SEA-SALT, and dead EARTH: this approaches to the very Essence of Sulphur, which as *Geoffry* observes, when treated with due Care, may be resolved into SALT, WATER, and EARTH; as is evident by distilling foetid distilled Oils several Times, with quick Lime, which, by this Treatment, yield in large Quantities a *volatile SALT* dissolved in *Pblegm*, together with a *Caput Mortuum*, or EARTH.

In the Resolution of the Ashes from the Coal of the Blood just now mentioned, the *fixed SALT* makes scarce $\frac{1}{300}$ th part of the Blood, of which again the one-fourth part is *Alcaline*. From this Salt, by the last Torture of the Fire, is procured something of an Acid, which is to be attributed partly to a Sea Salt, such as has been demonstrated to be in the Spirit of Blood, and partly to the vegetable Nature of the Food, as yet not subdued sufficiently. Hence it is found in Animals devouring Herbs, as well as in Man. The EARTH of the BLOOD, which makes about the one hundred, and fiftieth Portion, has in it some Particles, which may be attracted by the Loadstone, from which I suppose this Author concluded above, that the BLOOD has in it

some small Quantity of *Iron*: but if this be all the Proof, I should not think it much to be depended upon, unless the Experiments were made upon a variety of Subjects, and were still attended with the same Success: because it may happen that any particular Person, from persisting in a long course of *steel* Medicines, may have his Blood so impregnated with the same, as to afford sufficient matter for *magnetical* Attraction: beside, if the relation of some late Experiments be true, it may likewise happen that other Substances, as particles of *Fat* or *Tallow*, may produce the same Effect as Iron.

But to return: the *Serum* of the Blood being distilled, affords the same Principles as the BLOOD itself, only less of OIL, and more of WATER.

The Proportions here mentioned of the several component Parts of the Blood one to the other, are according to the Standard of later Writers. Our great Mr. BOYLE was one of the *first* who contributed his Share to discoveries of this Nature; for in the year 1684 he published at London his *Memoirs for the Natural History of human Blood, especially the Spirit of that Liquor*. Afterwards people abroad contented themselves for a Time with finding that there were in it two sorts of SALTS, and two sorts of OILS. “ *Est*
 “ *nimirum Sal volatilis & Sal fixus ad Marini*
 “ *naturam maximè accedens. Hæc autem simul*
mista

“ *mista variè Sanguinem temperant pro Varia eo-*
 “ *rum Proportione. Sanguis etiam, eadem de*
 “ *Causâ, variè admisto Chylo afficitur, quod plu-*
 “ *ribus Experimentis detrebensum est. Atque*
 “ *hinc Forte oritur Maxima morborum Pars.*”

(*Clerici Physic. cap. ix. p. 317.*) The particular Proportions above mentioned are those set down by *Haller*, and he observes very justly, that they are not always the same; for indeed, in the Variety of Constitutions this must be impossible. His general Remark upon the chymical Process amounts only to this; that there are Liquids in the Blood, some heavier and more tenacious than others; some watry, and some inflammable; and that, for the most Part, the Blood has a Tendency to Putrefaction, and an alcalious Disposition; but this is supposed to happen from external Causes; for he adds, that in its whole, or natural State, it is neither *alcali* nor *acid*, but mild to the Taste, and a little Saltish; yet, in some Distempers it is sharp enough, and very near to Putrefaction, as in the SCURVY, wherein it eats away its Vessels; and in People ill of a DROPSY, the Water is next to *Alcaline*. He mentions other Experiments upon the Blood which approach to chymical; that in the Heat of Water moderately boiling, or above 150 Degrees, it will coagulate to an hard Substance, the Globules of which Substance afford the inflammable Matter before-mentioned, as likewise a *Pyrophorus*, which may be drawn from
 human

human Blood; and moreover, it is probable, that from these also arise the greatest Part of the pitchy Oils which the Torture of the Fire produces, which, by the Way, I think are all Arguments of its SULPHUREOUS Nature. As for the Threads (not the Chain of Globules) which have been observed to appear, in it when washed he says they are not in the Blood itself, but are formed by the warm Water. Further, the Blood may be coagulated by *rectified SPIRITS*, *vehement* or *mineral* Acids, as it is loosened and attenuated by *milder* Acids, *alkaline* Salts tho' fixed, but chiefly by Volatiles, acid Vegetables, Nitre, and other middle Salts; but it Effervesces with no SALTS at all. Lastly, violent *muscular* Motion, too great external Heat, or a very high Fever, will produce Putrefaction in the Blood, even while a Man is yet alive.

The *microscopical* Observers, upon receiving fresh Blood into a Glass Tube, and even in the Veins of living Animals, have distinguished red Globules, which appear from their changeable Figures to be soft and yielding to Pressure, and which without doubt constitute the CRUOR or GORE of the Blood. Those Globules float in a thinner Liquid, in which, by the Help of the same Instrument, they discern other Globules less than the red; and moreover that such Globules as have been red they say, by the sole Effect of Heat and Chafing, will go off into the figure of those of the lesser Sort; so that the whole Mass may be

resolved at Length into a yellow Matter, even in a living Man. This inclines to favour the Hypothesis of *Leeuwenhoeck*, of which hereafter. The Diameter of one of these red Globules has been esteemed by the Curious in Experiments to make about $\frac{1}{3248}$ part of an Inch.

In the pale WATER, which was the Vehicle of the two Sorts of Globules before mentioned, the red and serous, the uncommon Force of the microscope has farther exhibited Globules of the aqueous, pellucid Sort, and the various *Spicula* of SALTS. One would think, however, by what follows, that this Author doubted of the Truth of his own Account; for he adds a little after. “ In aqueo
“ tenuiore liquamine, cujus Particulæ distin-
“ gui Nequeant, & aqua est, ” &c.

It seems this *Leeuwenhoeckian* System of Globules has been carried in some Particulars beyond Credibility. An Instance of this I find in *Essays Physiological and Practical, on the Nature and Circulation of the Blood*, lately published by Dr. SMITH, physician to the *Middlesex-Hospital*, This gentleman, to the above account which HALLER gives from *Leeuwenhoeck* adds, “ That he (*Leeuwenhoeck*) was e-
“ ven induced to believe, that the large red
“ Globules were composed of six lesser serous
“ Ones, compressed and united together; on
“ the contrary, that by rest, or a Defect of
“ the compinging Cause, the red Globules
“ would be decomposed again to their serous,
so

“ so that the only Difference between Blood
 “ and Serum consisted in a closer Union of
 “ the Globules of Serum; that one red Glo-
 “ bule, when not sufficiently compressed by
 “ the Action of the Vessels dissolves and se-
 “ parates into six yellow lesser ones; and that
 “ six of them, when again united, will form
 “ one Globule of Blood.”—*Smith's Essays*
 Page 5 and 6.

This Doctrine, which he says has been patronized by *Boerhaave*, and many other ingenious Physiologists, Dr. *Smith* refutes from a natural Experiment of the Moderns, by which I mean an Experiment, that has very little Art in it, the Blood remaining unaltered by Art before the Trial; which make the SORT, I intended last to mention in this short *History* of the more modern Observations, and Discoveries relating to the *Texture* of human Blood.

But to return to Dr. *Smith's Refutation of Leewenhoek*. “ The Cruor, says he, though
 “ it has the Appearance of an homogeneous
 “ Mass, when examined, will afford distinct
 “ and different Principles; the *Craſſamentum*,
 “ properly so called, which of itself is of a
 “ whitish or greyish Colour, and a red Matter,
 “ the tinging Particles of the Blood, on
 “ which depends its red Colour. These,
 “ though they naturally attract and adhere to
 “ each other, may by various Methods be ob-
 “ tained separate; for if new drawn Blood be
 “ continually stirred with a Feather, or stick,
 ’till

“ ’till it becomes Cold a considerable Quan-
 “ tity of a fibrous tough Substance, which by
 “ washing will become white, will adhere to
 “ the Stick, and the remaining part of the
 “ Blood thus deprived of its thicker Parts,
 “ will not concrete, but separates by Rest into
 “ two Substances, the Serum, which swims
 “ uppermost, and the red tinging Particles,
 “ which will be precipitated towards the Bot-
 “ tom of the Vessel, but by Agitation will
 “ rise again and fluctuate in the Serum. Or
 “ if Blood, as it flows from a wounded Vef-
 “ sel, be received into a Basin of warm Wa-
 “ ter, and well mixed with it, when cold the
 “ *Craffamentum* may be separated from the a-
 “ queous Parts, of a whitish or greyish Co-
 “ lour, lightly tinged with red: The Fluid
 “ remaining in the Basin appears thin, and
 “ of a very florid red Colour, as consisting
 “ only of the Serum, and tinging Particles
 “ of the Blood, mixed and united with the
 “ Water. Or again, “ if the Cruor be re-
 “ peatedly washed with cold Water, it parts
 “ with it’s red Colour, and then appears a fi-
 “ brous light-coloured Substance, something
 “ similar to the coagulated Serum: The red
 “ Particles diffused through the Water will
 “ tinge it with their Colour, though the
 “ same cannot be made to wash them out be-
 “ yond a certain Proportion, sufficient to con-
 “ vert it into a bright red Tincture, which,
 “ upon standing, does not precipitate it’s Co-
 “ lour,

“Iour, much less will there appear any Inclination to Yellowness; or Resemblance to Serum.” The Doctor asks, will not this be sufficient to contradict the received Opinion, that the red Globules are owing to fix yellow ones united; or that, upon the Resolution or Attenuation of a red Globule, it will be converted into *Serum*? &c.

His Attempt afterwards to reconcile his *Hypothesis* with the *microscopical* Appearance of *Globules*, is very reasonable. Nor is the Practice of washing the Blood, and blending it with warm Water to obtain a Separation of its Principles, any thing new or singular, as appears by the following mixed Experiment, which, for the Sake of confirming the Doctor’s Opinion, as well as preserving all due Regard to the Use of Microscopes, I shall transcribe from *Le Clerc*.—*Phys. lib. iv. p. 316.*

“*Sanguis diligenter Microscopii ope Inspectus, constare deprehenditur Tribus partibus.—1. Est Serum aqueum, quod constat Particulis Polygonis & pellucidis. 2. Sunt variæ Fibræ, seu particulæ Fibrosæ admistæ. 3. Globuli rubri. Sed quia in sanguine Vena emisso et Coagulato, fibrosa Substantia partim rubris Particulis est intertexta, massamque concretam cum iis conficit, Partim in Sero aqueo Dissoluta est, ideo olim in sanguine Purpureum duntaxat Liqueorum & pellucidum aqueum esse existimabant. Sed ubi Microscopium adhiberi cæpit fibrosa Substantia Inventa est.*

Uf

“ *Ut autem cognoscamus, quanta sit Horum*
 “ *trium in sanguine copia hoc Institui potest Ex-*
 “ *perimentum. Libræ aquæ calidæ tantum san-*
 “ *guinis ex aperta Vena proficientis adfundi si-*
 “ *namus, ut aquam pondere Unciarum trium &*
 “ *Drachmæ unius augeat. Deinde hic si per*
 “ *Chartum coletur, in Charta manebit crassioris*
 “ *& Concreti Sanguinis, Uncia dimidia, cum*
 “ *Drachma una. Substantiæ vero Aquæ leni*
 “ *Distillatione, in vas subjectum Dilapsæ erunt*
 “ *Libra una sex Unciæ & Drachma sex. Sub-*
 “ *stantiæ vero fuscæ, erunt Drachmæ duæ cum*
 “ *Semisse. Itaque aquæ Drachmæ tres cum di-*
 “ *midio in auras abire videntur, aut in Charta,*
 “ *dum Percolatur hæerere. Quia tamen rubris*
 “ *Globulis videtur adhuc admixta esse Substantia*
 “ *illa Fibrosa, massa sanguinea, quæ superest,*
 “ *iterum est tepida Aquâ Diluenda, deinde Per-*
 “ *colanda; ac tandem post lenem exsiccationem,*
 “ *sanguine Tincturæ supererunt, Drachmæ duæ*
 “ *& aliquot Grana. Unde colligere est, vix duo-*
 “ *decimam esse in sanguine Rubicundæ materiæ*
 “ *Partem, eumque potissimum Serosis, & fibrosis*
 “ *particulis constare. Hoc autem Experimen-*
 “ *tum in sanguine Hominis plenâ valetudine*
 “ *utentis sumptum est.”*

Beside these Arguments already mentioned;
 to prove that the *red Globules* of the Blood
 are not a composition of *serous Globules*, but
 Principles of a distinct Nature, & *sui Generis*,
 I shall just mention a Case, which to me, who
 saw the Appearance, amounts to a very sen-
 sible

sible Conviction. A Gentleman about the Age of eight and twenty Years, of an Habit of Body, neither athletic nor over delicate, on a hot Summer's Afternoon, had rode with great Expedition upon a hard trotting Horse from *Preston* in *Lancashire*, to *Warrington*; the distance perhaps might be about thirty of our measured Miles. He spent his evening chearfully, went to bed well, and from the Violence of the exercise slept very sound. In the Morning reaching for a white glazed Chamber-pot, in which he had made Water going to Bed; his Eyes being half open, he was surprized to see the Urine look like Blood; this made him rub his Eyes to obtain a more distinct View, when he saw clearly that certain red Particles, diffused through the Water, had tinged it with their Colour sufficient to convert it to a bright red Tincture, while some of the grosser Particles lay like the Sediment of Brick-dust at the Bottom. Upon which, he enquired of the Servants whether they ever made use of Brick-dust to scower those Utenfils, which they denied. He thereupon sent for one Mr. *Lancaster* an Apothecary, who then lived opposite to the *Eagle and Child* Inn; and upon Examination they found that there was nothing Gritty in this Appearance of Brick-dust, as is often found in that red Gravel, which will concrete and shoot in Streaks along the Glazing of a white Chamber-pot; on the contrary, these
red

red Particles were rather soft, and yielding to the Touch, and scarce palpable between the Fingers; whereupon the Gentleman himself, and the Apothecary, concluded, that these must be some red *GLOBULES* of the *BLOOD*, forced from the Emulgent Arteries by a precipitate Secretion, into the Pelvis of the Kidney, which might be occasioned by the violent Agitation of the Horse, and Dilatation of the Vessels, from the very great *Heat* of the Weather.

There is a Relation of a *Case* or two in Dr. *Springsfelt's* Account of the Virtues of the *Baths* of *Carlsbade* in dissolving the *urinary* Stone, which confirms me in the Opinion, that the *red GLOBULES* in the Blood exist independent of the *SERUM*, and that those mentioned in the former *Case* to be voided by Urine were Globules of this Sort. He tells us, that while these Waters *dissolved* or *diminished* a *STONE* taken from the Bladder, yet if a Person not ill of that Disorder daily made Water upon such a Stone, the Urine would gradually enlarge it, by forming *CRYSTALS* all around the Surface, which *CRYSTALS* were of two Colours, *red*, and *white*; and that the Virtues of the *Caroline BATHS* would not dissolve the *red Crystals*, tho' they would the *white*, from whence Dr. *Leiberkubnius* another *German* Physician there making Experiments infers, that the *white Crystals* form the *Nucleus* of the Stone, and not the *red*:

If then these *white Crystals* (as is probable) are made from *Salts*, or other Matter floating

in the *Serum*: Here is a Demonstration from the different Effects of the Waters, that the *Matter* of the *Serum* is different by Nature from the *Matter* of the *red Globules* of the *Blood*; and consequently, that the one cannot be generated from, or composed of the other.

I have only to add to this Chapter some Experiments made upon the *Serum* of the *Blood* in its natural State, as they are recorded by Dr. *Freind* in his *Emmenologia*.

Cum Sero sanguinis humani admixta sunt sequentia.

1. *Tinct. Aloes cum Aq. Menth. extract.*

Decoctum Sabinæ.

Aqua Sabinæ still.

Aq. Fontan.

Decoctum Gentianæ.

Ari.

Sarzæ.

Cbinæ.

Spir. Sal. Armon. cum Cin. Clavell.

cum Calce vivâ.

Succinatus.

Spir Tartari.

Ol. Semin. Carui.

Panacea Liq. D. Jones.

Laudanum Liq. Sydenb.

Spir. Croci.

Spir. Terebinth.

Tinctura Martis Tartari.

Spir. Guaiaci.

Sp. Corn. Cerv.

Ol. Tereb. Guaiac. Lav. Cariophyl.

Color pro liquoris ratione varius, *seri* tamen compages aliquanto tenuior facta; quæ, ad diem unum aut alterum, immutata perstitit.

2. *Decoctum Corticis Peruviani.* Serum multò magis, quàm à prioribus, in fluorem reductum.

3. *Spir. Vini Campborat.* Fortiter coagulatur. Phialæ inditum cùm aliquamdiu remanserit, in fundo apparuit *Hypostasis* satis copiosa : liquoris pars superior clara, & pellucens.

4. *Spir Vini Rectif.* Phialâ pariter inclusum, sine ullâ præcipitatione turbidum permanfit.

5. *Tinctura Scammonii.*

Castorei.

Succini simpl.

Sulphuris.

Corticis Peruv.

} Serum mediocriter.
coagulabatur. Eadem exhibuit *Spir. Vini Tartari.* & *Ratafia.*

6. *Tinctura Croci:*

Metallorum.

Potestates Succini.

Sal Volatilis Oleosus.

} Leve aliquod coagulum.

7. *Tinctura Martis Mynsichti.* Coagulum forte. Ad fundum demissa est Massa, instar Gummi, concreta.

8. *Tinctura Antimonii Diaphor.* Turbatum, & aliquatenus concretum.

9. *Tinct. Jalapii.*

Succini cum Sal Armon. pp.

} tantùm turbidius.

10. *Tinctura Coccinea, ex Spec. Diambrae & Cochinellâ cum Spir. Vini extracta,* Nullum ferè coagulum.

C H A P. XXIV.

The Description of the Parts resumed both in the Abdomen, and the Thorax, to facilitate the Knowledge of those more immediately concerned in Circulation.

AFTER this Account of the Texture of the Blood, it will be necessary, according to the Method I proposed, to have Recourse again to ANATOMY, in order to describe the *Situation*, and *Use* of the PARTS concerned in its CIRCULATION. The *Stomach* and *Intestines*, &c. the Dissection of which served to explain a great Part of the Business of CHYLIFICATION, being now removed from the *Abdomen*, the Muscles also thrown by, and *Peritonæum* and *Mesentery* taken out, the *Cavity* exhibits the rest of the *Viscera*, and *Vasa* in SITU, and as many as can be generally comprehended at one View, are these, that follow.

The superior *Convex* Surface of the Liver. And by turning up a little, its inferior *Concave* Surface appears. Then the *Ligamentum umbilicale* is turned up on the cartilaginous Endings of the Ribs: this shews the *Gall-bladder* filled with *Gall*; the *Ductus cysticus*; the *Ductus hepaticus*, joining with the *Cysticus*, and making the *Ductus communis*. A little below there is generally left a small Portion of the *Duodenum*, which is slit and laid open, to shew the

the *Exit*, or rather the Entrance of the *biliary* or *pancreatick Ducts*, which is done by thrusting a Probe more direct into the *Ductus pancreaticus*, and another more oblique and ascending, thro' the same Orifice or Caruncle of the *Duodenum*, into the *Ductus communis* of the *Bile*. To the *Left* of this Section of the *Duodenum* appears the Body of the *Pancreas*, then the *Spleen*; a little descending from the *Pancreas*, the emulgent Vessels of the *left Side*, under the which, near the great *Artery*, lies the *Receptaculum Chyli*, before described. Then the two *Kidnies*, of which the *right* is somewhat lower then the *left*. Between these *Kidnies*, on the *left Side*, there is the *descending Trunk* of the *great Artery*; close to the *right* of this the *ascending Trunk* of the *Vena cava*, by some called the *descending* being below the *Liver*. The two *Spermatick Arteries* spring from the *Trunk* of the *great Artery*, the *right* passes over the the *Cava*. Exterior to these on each *Side* are the two *spermatick Veins*, the *right* emptying itself into the *Vena cava*, the *left* into the *Emulgent Vein*. The *Spermatick Veins* and *Arteries* pass over the *Muscles* called *Psoæ* to the *Testes*. The two *Ureters* descend on each *Side* over the *Branches* of the *great Artery* to the *Bladder*. The *Uracus*, which is inserted about the *Fundus* of the *Bladder*, ANATOMISTS in this Exhibition turn downwards; then they shew the *Dasa deferentia* passing from

from each Testicle to the *Vesiculæ seminales*, &c.

The *Thorax* being opened, discovers first its proper internal *containing* Parts, the *Pleura*, the *Mediastinum* and the *Diaphragm*; then the Parts *contained*, which are either *Viscera* or *Vasa*, i.e. *Bowels* or *Vessels*. The *BOWELS* are the *Heart*, and *Lungs*: of the *VESSELS*, the most conspicuous are *four* in number: The *Vena cava*, that is one great Trunk of it (by some called *Ascendens*, as being above the Liver, by others *Descendens* from the Course of the *Blood* descending to the Heart) the *pulmonary Artery* the *pulmonary Vein*, and the *Aorta*, or *Arteria magna*. There is also in the *Thorax* the *Vena azygos*, or *sine Pari*. The *Vena Portæ* is of a mixed Nature between *Vein* and *Artery*, and belonging to the *Abdomen*, it has been mentioned before, tho' concerning its peculiar *Use*, I shall add a word or two in the next Chapter.



C H A P. XXV.

The Use, and Fabrick of the Arteries and Veins in General,

IT is the Business of the *Arteries* to carry out the Blood from the Heart, and that of *Veins* to return it. All the *Arteries* of the Body are *Branches* or Ramifications from the two Trunks of the *Aorta*, except the *pulmonary*

monary Artery : as all the Veins are Branches of the *Cava*, except the *pulmonary Vein* and the *Vena Portæ*, whose Branches arise from all the Branches of the *cæliack* and two *mesenterick* Arteries, except those of the *cæliack* and *superior mesenterick*, which are bestowed upon the Liver. The *Porta*, from its Rise, uniting by degrees into one Trunk, thus enters the Liver, and is there again distributed into five Branches ; in Use it is like an Artery, and has its Blood collected and brought into the *Cava*, not by *Anastomosis*, but by being strained through the *Parenchyma* of the Liver into the Branches of the *Cava*, there distributed for its Reception, after that a Supply of Blood has been given to the Liver, for the Separation of the *Bile*. If this be true concerning the Course of the Blood, the Ancients were deceived in supposing this Vein to arise from the Liver, where in Reality, its uses End.

With Regard to the Structure of the *Arteries* in general, they have three Coats, a *middle muscular*, and an *external* and *internal membranous*. The *Veins* are said to have the same ; the *internal* Coat of an *Artery* may be pretty easily separated, but not the *external* ; and tho' the *Veins* have *muscular* Fibres, yet Mr. *Chiselden* saysthathecouldneverseparateanyonedistinctly, into *three* Coats ; and in the Inside of the *Veins* there are many Valves, especially in the lower Limbs, to hinder any Reflux of the venal Blood, which otherwise would have

happened from the frequent Actions of the Muscles, on the outsides of the Veins; and both the *Arteries* and *Veins*, as they run in the inside of the Limb, or as they are dispersed in Parts, that suffer great Extentions, as the *Stomach*, *Guts*, and *Uterus*, are curved so much, as that when, these Parts come to be distended, they may comply with those Distensions by only being straitened, and so preserved from being stretched, which would lessen their *Diameters*. The small *Arteries* near the *Heart* go off from the large Trunk, at obtuse Angles, farther at less obtuse Angles, then at right Angles, farther still at acute Angles, and near the Extremities at very acute Angles, because the Blood in the Vessels far from the Heart moving with less Velocity, than the Blood in the Vessels near the Heart, the Blood in the collateral Branches more remote from the Heart wants the Advantage of a directer Course; and because a very large Branch arising out of another, might weaken too much the Sides of the Vessel, that Inconvenience, is prevented by increasing the Number, and so lessening the Size of the collateral Branches, where otherwise one large Branch would have served better, as in the going off of the *Subclavian* and *Carotid* Arteries, which might have gone off for some Space in one Trunk; but this *Mechanism* is more evident in the going off of the *Arteria Cœliaca* and *Mesenterica Superior*.

Superior. And the small Arteries always divide so, as that the lesser *Branches* may lie least in the Direction of the Blood flowing into them, which makes the Blood flow most freely into that Branch, that hath farthest to carry it ; and the smaller Branches arise more or less obliquely from the sides of other Arteries, according to the Proportion they bear to the Arteries they arise from, because an *Artery* comparatively large arising obliquely from the side of another, would make an Orifice in that, it arises from, too large, and weaken it. And both these Ends are at once brought about by making the Arteries, that give off the Branches, bend more or less towards the Branches they give off, according to the comparative Magnitude of the Branches given off.

The *Veins* do not arise as the *Antients* thought, from the *Liver*, but from the Extremities of the *Arteries*, being as it were the same Tube reflected. They make up *Trunks*, which accompany the *Arteries* in almost every Part of the Body, and have the same Names with the Arteries, which they thus accompany.

The *Veins* of the *Brain* unload themselves into the *Sinuses*, and the *Sinuses* into the *internal Jugulars* and *Cervicals*, and these into the *Subclavians*, which joining make the *Cava descendens*. The internal *Jugulars* are seated by the *Carotid Arteries*, and receive the Blood from
all

all Parts which the *Carotids* serve, except the hairy Scalp, and Part of the Neck.

The *Veins* of the *Limbs* are more than double the number of the *Arteries*, there being one on each side of each *Artery*, even to the smallest Branches, that we can trace, besides the *Veins*, which lie immediately under the Skin.

The *external Veins*, have frequent Communications with the *internal*, and are always fullest, when we use the most Exercise. Because the Blood being expanded by the Heat, which Exercise produces, it requires the Vessels to be distended, and the inner Vessels being compressed by the Actions of the Muscles, they cannot dilate themselves enough, while the other are capable of being much dilated; and this seems to be one of the chief Uses of the external Vessels.

In the *Thorax* besides the two *Cavæ*, there is the *Vein* called *Azygos*, or *sine Pari*. It is made up of the *Intercostal*, *phrenick* and *bronchial Veins*, and enters the *descending Cava* near the *Auricle*, as if its Use were to divert the descending Blood from falling too directly upon the Blood of the *ascending Cava*, and to direct the Blood of the *descending Cava* into the *Auricle*.

C H A P. XXVI.

Of the proper external containing Parts of the Thorax.

THE *external* Appearance of this Region of the Body, and its *common* Teguments, have been briefly described in the Beginning of the Book: the *proper internal containing* Parts are three in Number, the *Pleura*, the *Mediastinum*, and the *Diaphragm*.

The *Diaphragm* is composed of two Muscles, which divide the Middle from the lower Cavity. The first and superior Muscle arises from the *Sternum*, and the End of the last Ribs on each Side. Its Fibres, from this semi-circular Origination, tend towards their Centre, and terminate in a Tendon or *Aponeurosis*, which hath always been taken for the nervous Part of the Midriff. The second and inferior Muscle comes from the *Vertebræ* of the Loins by two Productions, of which that on the right Side comes from the first, second, and third *Vertebræ* of the Loins; that on the left Side is somewhat shorter; and both these Productions join and make the lower Part of the Midriff, which joins its Tendon with the Tendon of the other, so as that they make but one Membrane, or rather Partition.

The

The Midriff is covered with a Membrane from the *Pleura* on its upper Side, and by the *Peritonæum* on its lower Side; it is pierced in its middle, for the Passage of the *Vena Cava*; in its lower Part, for the *Oesophagus*, and the *Nerves* which go to the upper Orifice of the Stomach, and betwixt the Productions of the inferior Muscle, passes the *Aorta*, the Thoracic Duct, and the *Vena Azygos*.

The Midriff receives *Arteries* and *Veins*, called *Phrenicæ*, from the *Cava* and *Aorta*; and sometimes on its lower Part two Branches from the *Vena Adiposa*, and two *Arteries* from the *Lumbares*. It has two *Nerves* which come from the third *Vertebræ* of the Neck, which pass through the Cavity of the *Thorax*, and are dispersed in the Muscles of the Midriff.

The Midriff, in its natural Situation, is convex on the upper Side towards the Breast, and concave on its lower Side towards the Belly: Therefore when its Fibres swell and contract, it must become plain on each Side, and consequently the Cavity of the Breast is enlarged, to give Liberty to the Lungs to receive the Air in the Inspiration; and the Stomach and Intestines are pressed for the Distribution of the Chyle; but it diminishes the Cavity of the Breast, when it resumes its natural Situation, and presses the Lungs for the Expulsion of the Air in Expiration.

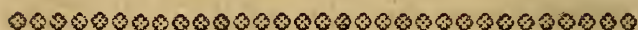
The *Pleura* is a double Membrane which covers all the Cavity of the *Thorax*, it arises
from

from the *Vertebræ* of the Back, ascends on each Side upon the Ribs to the middle of the *Sternum*. It is fixed to the *Periosteum* of the Ribs, to the internal intercostal *Muscles*, and it covers the Midriff. Its Side towards the Cavity is smooth and equal, but that which is fixed to the Ribs is rough.

The *Mediastinum* is a double Membrane, formed by the Continuation of the *Pleura*, which comes from the *Sternum*, and goes straight down thro' the middle of the *Thorax* to the *Vertebræ*, dividing the Cavity in two. It contains, in its doubling, the Heart in its *Pericardium*; the *Vena Cava*, the *Oesophagus*, and the Stomachick Nerves. The Membranes of the *Mediastinum* are finer and thinner than the *Pleura*, and they have a little Fat. The *Mediastinum* receives Branches of *Veins* and *Arteries* from the Mamillary and Diaphragmatick, and one Proper, called *Mediastina*; its *Nerves* come from the Stomachick; it has also some Lymphaticks, which open into the Thoracick Duct. The *Mediastinum* divides the *Thorax* into two Parts, to the End that one Lobe of the Lungs may officiate, if the other be hindred by a Wound on the other Side of the *Thorax*. Sometimes there is a Matter contained betwixt its Membranes, immediately under the *Sternum*, which may occasion the Trepaning of this Place.

The *Thymus* is a conglobate Gland, situated
in

in the upper Part of the *Thorax* under the *Claviculæ*, where the *Cava* and *Aorta* divide into the Subclavian Branches. This Gland is big in Infants, but as they grow in Age, it grows less. Its *Arteries* and *Veins* are Branches of the *Carotides* and *Jugulars*. It has *Nerves* from the *Par Vagum*, and its Lymphatick Vessels discharge themselves in the *Ductus Thoracicus*.



C H A P. XXVII.

Of the Parts contained in the Thorax, the Lungs and Heart.

THE Parts contained in the Thorax which are the only ones, that directly concern our Present Purpose, namely that of describing the Circulation of the Blood are either *Viscera* or *Vasa*: that is *Bowels* or *Vessels*.

The *Bowels*, as was said, in the former general Division, are the *Heart* and *Lungs*. The *Vessels* here chiefly to be considered, are either *Blood-Vessels*, which were mentioned above, such as the *Vena Cava*, the *pulmonary Vein*, the *pulmonary Artery* and the *Aorta* or *great Artery*, or else *Vessels*, that convey the *Air* as the *Aspera Arteria*, &c. i. e. the *Windpipe* and its *Channels*, which serve to the *Respiration* of the *Lungs*.

The *Lungs*, which are the immediate Organ of *Respiration*, consist of *Vessels* and *embranchous*

branous Vesicles. They are connected above to the *Fauces* by means of the *Trachea*, and below to the *Vertebræ* of the *Thorax*, and to the *Sternum* and *Diaphragm* by means of the *Pleura*:

They are divided into two great *Lobes*, and those again into others lesser; the right sometimes into three or four, by means of some Fissures running from the fore to the back Edge:

The great *Lobes*, when inflated, resemble each of them a Horse's Hoof in Figure, but together they are liker an Ox's inverted.

The Substance of the Lungs is membranous, consisting chiefly of innumerable Cells or Vesicles, which seem to be nothing but Expansions of the Membranes of the *Bronchia* to which they hang, like Grapes in Clusters; so that by blowing into one of the Branches of the *Bronchia*, these Cells or Vesicles, which belong to it, will be blown up; the rest, which do not, remaining still flaccid and unaltered.

These Clusters of Vesicles or Cells are called the internal *Lobules*, by which Names they are distinguished from the lesser *Lobes* spoken of before. These *Lobules* are separated from one another by Interstices, which receive the Vessels, and are filled up with Membranes propagated from the *Lobules*, and lying some Parallel some Angular. These *Lobules* discover and display themselves very exactly, if the larger Trunks of the *Bronchia* be laid open, and the lesser
be

be blown into, by which means every *Lobule* belonging to that Branch will be inflated, and rise very distinctly, and shew its Extent.

The whole Substance of the Lungs is covered with a common Membrane, which is divisible into two Coats; the outer thin, smooth, and nervous; the inner somewhat thicker and rougher, consisting mostly of the Extremities of Vessels and Vesicles, through the Impression of which it is pitted, and resembles in some measure a Honey-Comb.

Some affirm, that there are in this Coat abundance of Perforations or Pores, so dispos'd, that they readily imbibe any Humidity from the Cavity of the *Thorax*, but suffer nothing to escape into it. But this, our Author says, is grounded upon no justifiable Observation.

Its Vessels are the *Bronchia*, the pulmonary and bronchial Arteries and Veins, Nerves and Lymphaticks. Of these Vessels some are *Proper*, some *Common*, in respect to the Service they are of to the rest of the Body; the *Common* are the *Bronchia*, the pulmonary Artery and Vein, the Nerves and the Lymphaticks. The *Proper* are the bronchial Artery and Vein.

The *Trachea*, just before it enters the Lungs, divides itself into two Branches, sending to each *Lobe* one; which are again divided into innumerable Ramifications, which are called *Bronchia*. The *Bronchia* and their Branches consist of Cartilages like the *Trachea*,
only

only here the Cartilages are perfectly circular, without any membranous hinder Part; of which, having left the *Oesophagus*, they have no need. These circular Cartilages are joined together by the Membranes, that invest them, and are capable of being shot out into Length upon Inspiration, and of shrinking up and running into one another in Expiration, when the Cavity of the *Thorax* is lessened. They send their little Ramifications to all the little Vesicles of the Lungs.

Along with these Air-Vessels run the Branches of the pulmonary Artery and Vein, sending their Ramifications exactly along with the other. The Artery bringing the Blood from the right Ventricle, and the Vein carrying it back to the left Ventricle of the Heart. Whether the Blood returns by the Vein impregnated with Air in the Lungs, is still a Question among some *Physicians*.

The Bronchial Artery arises from the hinder part of the *Aorta*, a little above the *Base* of the Heart; whence turning off to the right, it embraces the *Trachea*, and after sending off a Branch or two to the *Oesophagus*, it pursues the Course of the *Bronchia*, accompanying all their Branches through their whole Progress. This Artery is sometimes single, but oftner there are two of them, and sometimes three, which rise at about a Finger's Breadth, or less distance, from one another.

Concomitant to these Arteries is a Vein,
Q whose

whose Branches arise from the Ramifications of the Capillary Arteries. Whether the Blood returns by one or more Trunks, is not yet sufficiently apparent. These Vessels bring Blood for the Nutriment of the *Bronchia*, and Vesicles of the Lungs, and carry it back again.

Through the Lungs are distributed a great number of Lymphaticks attending generally the Blood-Vessels, and being at length collected, empty themselves into the Thoracick Duct.

Dr. *Willis*, contrary to the vulgar Opinion, ascribes to the Lungs a great Number of Nerves, which come from the Trunk of the *Par Vagum*, which being distributed through the Substance of the Lungs, embrace the aërious and sanguiferous Vessels.

The Heart is a Muscle situated in the middle of the Thorax, into which the two great Veins, (*viz.* Cava and Pulmonaris) discharge themselves by the Mediation of its Auricles, and from whence the Aorta and Pulmonary Arteries arise, and by its reciprocal Action of Constriction and Dilatation is the main Instrument of the Circulation of the Blood, and the Foundation of all Vital Action.

It is included in a *Capsula* or *Pouch*, which consists of a double Membrane, the Inner arising from the Tunicks of the Vessels of the Heart, and the Outer from the *Mediastinum*.

Its Figure is like that of the Heart which is *Conoid*, and it embraces the Heart laxly, allowing room for its *Pulsation*.

In

In Humane Bodies, and in them only, it is connected below, to the *Tendinous* part, or *Centre* of the *Diaphragm*, whereas in Brutes it is loose.

Externally it adheres to the *Mediastinum*, and in the superior Part to the Veins and Arteries of the Heart, for the passage of which it has several Perforations.

It receives Arteries and Veins from the *Mediastins*, and from the superior *Diaphragmatics*, in the upper part, and in the lower from the *Pbrenick*. Its Nerves come from the neighbouring Branches of the *Par Vagum*. And it has likewise some *Lymphaticks* which empty themselves into the *Thoracick Duct*.

Its Use is supposed to be the Defence of the Heart, as likewise to contain a soft serous Humour, which may serve to lubricate and moisten the Heart.

This latter Opinion has been somewhat controverted of late by some who think that this Water is not naturally there, but that it is separated forcibly during those Convulsive Agonies, which usually supervene in *Articulo Mortis*.

This Opinion is grounded on the Difficulty that Anatomists have met with in tracing its passage: For it does not yet plainly appear which way it comes, nor how it is carried off: And it is hard to imagine that the quantity always remains the same, or that it could do so without Putrefaction: Yet the Passages
Q 2
through

through which it should be shifted, not being yet demonstratively discovered, I must be contented to leave it, as I find it, *sub Judice Littem.*

The Doubt has been as great likewise whence this Humour was separated, The most recent Opinion, and the most probable is, that it is secreted by some Glands about the Basis of the Heart. However it seems to me to be necessary by its Lubrication to prevent any Inflammation that might probably arise from the dry Friction of the Heart and its *Capsula*. But these things are deliver'd not Dogmatically but Problematically, and left to future Inquiry.

The Figure of the Heart itself is that of a Cone or Pyramid reversed: The upper and broader part of which is called the Basis, and the lower the Cone or Point.

Its Magnitude is indeterminate, and differing in several Subjects according to their respective Dimensions. However its ordinary Length is about six Inches, and its Breadth at the Basis betwixt four and five, and the whole Circumference about fourteen.

It is situated in the middle of the *Thorax*, between the two Lobes of the Lungs; and is fastned to the *Mediastinum* and *Pericardium*, and supported by the great Blood-Vessels to which alone it is immediately connected, being for the convenience of its Motion disingaged from any other Impediments.

It

It is cover'd with a thin Membrane, which about the Basis is guarded with Fat.

It has two great Cavities or Ventricles of Capacities somewhat unequal: The right being of the two, larger, and capable of containing between two and three Ounces of Blood, the left not containing so much by about half an Ounce.

The *Ventricles* are divided by a thick fleshy Partition, consisting of the same Muscular Fibres that the *Parietes* of it do, and is called the *Septum*, the Figure of which is Concave towards the left Ventricle, and Convex towards the right. Between these Ventricles there is no immediate Communication. But the Blood circulates thro' the Lungs to arrive at one Ventricle from the other.

The *Parietes* or Sides of these Ventricles, are of a Thickness and Strength very unequal; the left being much thicker than the right because of its Office, which is to force the Blood through all parts of the Body; whereas the right drives it through the Lungs only, and is therein greatly assisted otherwise, as shall in proper place be shewn.

In these Ventricles are divers small Muscles derived, and as it were detached from the *Parietes* of the Ventricles, and connected by *Tendinous* Extremities to the *Valves* of the Heart and are by Authors diversly called *Columnæ Carnæ*, *Lacertuli*, &c. and these little Muscles or *Columnæ Carnæ*, being fastned to the

Parietes of the Heart on one side, and the *Tricuspid* and *Mitral Valves* on the other, do by their Contraction in the *Systole* of the Heart draw out the *Valves*, and by that means not only shut up the Orifices of the Veins, but, as the Ingenious Mr. *Cowper* observes, *More exactly close the Ventricles in their Systole, than they could have been, had they been smooth.*

These *Ventricles* are capped or covered each with an *Auricle*: These *Auricles* are two Muscles consisting of a double order of fleshy Fibres, as the *Ventricles* of the Heart themselves do, whose Proportion they seem exactly to follow, both as to Strength and Capacity, and in the Tendons of which they terminate. These *Auricles* are moved regularly after the manner of the Heart, the order only reversed, that is, they are contracted whilst the Heart is dilated, and dilated whilst the Heart is contracted.

These Vessels which proceed from, and terminate in the Heart, and its Auricles are two Arteries, the *Aorta* and the *Pulmonary Artery*, which have their Origination from the *Ventricles* of the Heart: The *Aorta* from the left, and the *Pulmonary* from the right: And two Veins which terminate in the Auricles of the *Cava*, or great Vein in the right; and the *Pulmonary Vein* in the left.

At the respective Orifices of these Vessels are placed *Valves*. At the Orifice of the Arteries, within each Artery are fix'd three *Semilunar*

semilunar Valves, that is, three Membranes of a *Semilunar* Figure, which being expanded close the Orifice of the Artery, and hinder the Relapse of the Blood into the Heart at the time of its Dilatation. At the Mouth of the right Ventricle of the Heart, just at its Junction with the Auricle, are placed three other *Valves* called *Tricuspides* from their having three Points, which are fastned by tendinous Fibres to the *Columnæ Carneæ*, before-mentioned, and upon the Contraction or *Systole* of the Heart close the Orifice of it, and hinder the Blood from recurring into the great Vein. The same Office the *Valvulæ Mitrales* (which are in number but two, and so called from their resemblance of a Mitre) do at the *Exit* of the Left Ventricle, stopping the Return of the Blood into the *Pulmonary Vein*:

The Substance of the Heart itself is intirely Fleshy or Tendinous, consisting of a continued Series of *Muscular Fibres* variously contorted or wound up, and ending at the Orifices of the respective Ventricles, and there forming the Tendons, by which means they make the Heart a double Muscle; or as some think two Muscles.

As soon as the proper Membrane is taken off, there appear on the outward Surface on the right Ventricle, some slender strait Fibres tending to, and ending in the *Basis*.

Imme-

Immediately under these lies a double Order of *Spiral Fibres*. The Exterior Order of these ascend obliquely from the *Septum Cordis* to the *Basis*, forming thereby a sort of *Helix* or *Cochlea*.

The Interior Order takes a Course just contrary to those which they lie under, and springing from the right side, wind obliquely towards the left, incompassing both *Ventricles*, and ending in the *Basis* on the left side, and forming a *Helix* of an Inverse Order.

These Fibres are best discerned in the unraveling a Sheep's or Ox's Heart after they have been well boiled. In which as soon as the Membrane of the Heart is taken off, the first Order readily appears, the Fibres of which do not all of them reach from the *Basis* to the *Cone*, but some of them taking a much shorter Turn, as soon as they have measured about half the Circumference of the Heart, turning about with a Kind of an Arch, go with an oblique Course to the Tendon of the other Side and Ventricle.

After these Fibres are removed, those of the left Ventricle appear, among which there are no strait ones, but first appears a Series of Fibres running spirally to the left, under which, as in the right Ventricle, lye another Order running just the contrary way. These Fibres do not within the right Ventricle, extend only to the outward *Paries*, but encompassing the whole Ventricle, make the *Septum*
apper-

appertain peculiarly to, and be a part of the left Ventricle. Many of these Fibres, instead of terminating as the rest do in the Tendons of the *Heart*, run inwards and form the *Columnæ Carneæ*, of which we have spoken before. Others reaching down to the *Cone* are wound about it, and form that Circle which is called the *Centre*.

The Structure of the Auricles is so like that of the Heart itself, that it needs no particular Description.

The Heart has its proper Blood Vessels, two Arteries springing from the Entrance of the *Aorta*, and one larger Vein with one or two lesser, all which from their encompassing the Heart are called *Coronariæ*.

The Nerves of the *Heart* and its Auricles, come from a *Plexus* of the *Par Vagum*, situated in the *Thorax* a little above the *Heart*, and called by *Willis*, *Plexus Cardiacus*.

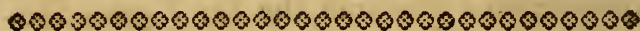
It has some *Lymphæducts* which carry the *Lymph* from the *Heart* to the *Thoracick Duct*.

The Use of the *Heart* and its *Auricles* is to circulate the Blood through the whole Body, and their Motion is alternate, or opposite to each other, the Auricles being dilated to receive the reflux Blood whilst the *Heart* is contracted, and contracted whilst the Heart is dilated to drive the Blood into it.

By

By means of the right Ventricle the Blood is driven through the *Pulmonary* Artery into the Lungs, and by the *Pulmonary* Vein is returned again into the left Auricle, then into the left Ventricle, from whence through the *Arteria Aorta* it is distributed all over the rest of the Body, and thence returned again to the right Ventricle by the *Vena Cava*, so making an entire Circulation thro' the whole Body. This through the *Aorta* and *Cava* being a longer Circuit than that through the Lungs, a greater force is necessary to perform it, and therefore the *Parietes* of the Left Ventricle are by Nature made much stronger than that of the Right.

Of the *Foramen Ovale* and *Canalis Arteriosus* in a *Fœtus*, we shall take Notice hereafter.



C H A P. XXVIII.

Of the Causes of the Circulation of the Blood.

THIS Reciprocal *Æstus* of the *Heart* has given the Learned abundance of Trouble; who finding nothing peculiar in the Structure, which should necessarily occasion it, nor any Antagonist, whose Re-action should produce it, have been extreamly perplexed to find out the Cause of it.

For, tho' it should be granted, that the Muscular Fibres of the Heart acted by the Nerves, are the immediate Instruments of its

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Constriction or *Systole*, yet it must not be denied, that the Intercostal Muscles and *Diaphragm* are of great Service to aid and facilitate this Contraction, by opening a Passage for the Blood through the Lungs ; which denied, would be an invincible Obstacle, (he means to the Discharge, and therefore to the Contraction.)

Neither do they promote it that way only. The manner how they farther assist the Heart in its Contraction, will appear manifestly, if we consider the different Posture, Situation and Capacity of the Blood-Vessels of the Lungs, in the several times of Elevation and Depression of the *Costæ*.

The Pulmonary Artery rises from the right Ventricle of the Heart, and runs in one Trunk till it comes to the *Aspera Arteria*, where it is divided, and sends a Branch along with each Division of the *Aspera Arteria*, according to all the minutest Subdivisions. of which it is likewise subdivided, accompanying all the *Bronchi* in their whole Progress through the Lungs.

The Pulmonary Vein, which empties itself into the Left Ventricle of the Heart, spreads itself on the *Aspera Arteria* and *Bronchi*, in the same manner that the Artery does.

The necessary Consequence of this Disposition is, that this Artery and Vein being co-extended with, and fastened to the *Bronchi*, must needs suffer such Alteration of superficial Dimen-

Dimensions, as the *Bronchi* do in the Elevation and Depreffion of the *Costæ*.

While the Ribs are in a State of Depreffion (whether before Commerce with the external Air or after) the Annular Cartilages of the *Bronchi* shrink one into another, and by that means their Dimensions are exceedingly contracted, In Conformity to this Condition of the *Bronchi*, the Pulmonary Artery and Vein must likewise, either by means of their Muscular Coats, contract themselves to the same Dimensions, or lye in Folds or Corrugations, which is less probable.

On the other hand, when the Ribs are elevated, and the *Diaphragm* bears downwards, the Air rushing into the Lungs, shoots out the Cartilaginous Rings, and divaricates the Branches of the *Trachea*, and by them extends and divaricates the several Divisions of the Pulmonary Artery and Vein, and thereby lengthens and enlarges their Cavities.

This enlargement of their Cavities is very considerable, not only upon the Score of the Addition, which they receive in length thereby, but also upon the account of their Divarication. For whereas, when the Ribs are depressed, and the Lungs subside, the Blood-Vessels are not only contracted, (as I have already observed) but their Branches, which are exceeding numerous, approach one another, and lye in juxta-position, by which their Cavities are very much compressed and straitened :
When

When the Ribs are elevated, and the Lungs turgid with Air, not only the Fibres, by which their Coats in the opposite State were contracted, are extended; but those innumerable Vessels, which lying before in Lines almost parallel one upon another, compress by one another, making an acute Angle at their Junctures, are divaricated and separated from each other, and make an obtuse, whereby their Channels are widened.

Thus a Passage is opened to the Blood, from the Right Ventricle of the Heart to the Left, through the Lungs, to which it could not otherwise pass; and the Opposition which the Blood contained in that Ventricle, must otherwise necessarily have made to its Constriction, is taken off, and the *Systole* thereby facilitated.

As in the Elevation of the *Costæ*, the Blood, by the Passage that is opened for it, is in a manner solicited into the Lungs, so in the Depression of them, by the Subsidence of the Lungs and the Contraction of the Blood-Vessels, both which are consequent thereof, the Blood is forcibly driven, as it were, with an *Embolum*, thro' the Pulmonary Vein into the Left Ventricle of the Heart. And this, together with the general Compression of the Body, by the Weight of the *Atmosphere*, which surrounds and presses upon the whole Surface of it, is that Power which causes the Blood to mount in the Veins, after the Force impressed upon it by the Heart is broken and spent, and
which

which is sufficient to force the Heart from its natural State to Dilatation.

He that is able to compute the Weight of a Column of Air, equal to the Surface of the whole Body, will readily grant it a Power sufficient for the Effects, which are here ascribed to it. And, when he considers, that the Bodies of Animals are compressible Machines, he will find that it must of necessity affect them in the manner here laid down. But though our Bodies be entirely composed of *Tubuli*, or Vessels filled with Fluids, yet this Pressure, how great soever, being equal, could have no effect upon them, if the superficial Dimensions were not easily variable; because, being compressed on all Parts with the same Degree of Force, the contained Fluids could not any where begin to recede, and make way for the rest to follow, but would remain as fixed and immovable, as if they were actually solid. But by the Dilatation of the *Thorax*, Room is made for their Fluids to move, and by the Coarctation of it, fresh Motion is impressed, which is the main Spring whereby the Circulation is set to work and kept going.

Chiselden objects to this System of *Drake's*, and says, “ that it requires the *Systole* and *Diastole* of the Heart to keep Time with *Expiration* and *Inspiration*, which is contrary to Experience.”

But supposing it true that, the Motion of the Lungs does not coincide in Point of Time with

with the *Systole*, and *Diastole* of the Heart, that Circumstance nevertheless does not destroy the Truth of the Fact, that *Respiration* is in Part the Cause of *Circulation*.

We admit of many things as true where the *Modus operandi*, is not explained: there is not in the whole *Animal Oeconomy*, a more remarkable, or at the same Time a more certain *Phænomenon*, than the *Ascent* of the *Chyle* in the thoracick *Duct*, and yet *Physicians* (from the Age of *Jo. Waley* down to **Dr. Whytt*) are generally so very silent as to the *Causa proxima* of that Ascent, that like our modern *Commentators* upon the *Bible*, when they meet with a difficult Passage, they never say a Word about it. It is universally believed, and it is very plain from Observations upon *Ligatures* and *Valves*, that the Passage of the Blood thro' the Heart and the Lungs, is performed in the Manner, commonly represented; and yet the *Phænomenon* of the *Pulse* can hardly, upon the *Principles* of *natural Philosophy* be reconciled, with this *Hypothesis*: Notwithstanding which, the Passage of the Blood thro' the *Cells*, *Cavities*, and *Vessels*, in the Order described, is not denied, tho' the Cause of the Pulse may be but ill explained from this Hypothesis.

The Heart, suspended by its own Vessels, represents the *Pendulum* of a Clock, with the Ball at Bottom. Now what makes an alternate Pulse, or Vibration of the Pendulum, is the

* *Physiological Essays*. p. 79.

the *Vis Percussionis*, or Stroke of one of the Teeth of the Crown Wheel upon one of the Palates of the Verge of the Pendulum; and there are as many Vibrations as there are Strokes. Apply this Image and Mechanism to the Heart and how is the Pulse explained by it?

Here the *Stroke*, or *Percussion*, will be at the *Bottom* of the *Pendulum*, and not at the *Top*. For tho' Dr. *Whytt* would have us believe, that the Force of the Heart is only a Force of Compression, yet beside this Compression; there certainly is, as *Borelli* has observed, a *Vis Percussionis*. There is a certain *Spring*, or *Bounce*, or *Vibration* of the whole, which is owing to the *Spring* of the *Fibres*, and *Discharge* of the *Liquor* from one Cavity to another, upon Contraction. Before the Blood has passed from the right Auricle thro all the other Passages into the *Aorta*, there will be *four* of these Vibrations, or at least four *Contractions*. Considering the Heart then in this pendulous State and thus affected, it will be natural to ask; if any one *Systole* produces a sensible Vibration, why should not every *Systole*, as they are represented to be near alike in Force, produce the same? If it be answered, that the *Auricles* and *Ventricles* are each contracted *together*, and therefore their *compound Systole* affords but *Two* sensible *Vibrations*, in the whole Operation: There arises a Difficulty of another Sort; for one would then ask, whether in this *compound Systole* in each
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of these Parts, that is to say, of *Auricle* and *Auricle* together, and *Ventricle* and *Ventricle*, the *Vis Percussionis* be *lateral*, or a *latere*? If so, these acting at the same Time *exopposito Latere*, by the Laws of *Mechanicks* the Part in the *Middle* would feel no Vibration at all, but stand still as the impinging Bodies would thus destroy each other's Forces, and the same may be observed of any Object placed between two *contracting* or *attracting* Forces, which are opposite: but if it be said that the *Vis Percussionis* or *Contraction* does not act a *latere* or in a Line, that forms right angles to the *Septum* or any intermediate Part: but rather almost in a *Perpendicular*, which shall pass from the *Basis* of the Heart to the *Mucro*, and draw the *Mucro* toward the *Basis*, why the *Vibration* which would follow upon such a *Contraction* would not resemble the *Cycloid* Form of Motion, but a Motion of direct *Ascent*, and *Descent*: whereas the *Strokes* of a Person's Heart, in an high Fever appear, as far as we can judge by laying an Hand upon the Breast, to be *backwards* and *forwards* like the Motion of the *Pendulum* of a repeating Clock; and yet if we feel the *Pulse* of an *Artery*, at the *Wrist*, or on the *Temple*, that *Pulse* appears, to be single, and not so much the Effect of a Stroke or *Impulse*, as of the *Discharge* of a new *Wave* of Blood from the left *Auricle* of the Heart into the *Aorta*; which new *Wave* gives that

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an *Undulation* to the whole Mass of Blood, which is felt by the Finger.

For my own Part, therefore, notwithstanding this Objection made by Mr. *Chiselden*, seeing that other Discoveries tho' generally believed are not without their Difficulties, I so far adhere to Dr. *Drake's* Opinion as to think the Action of the Lungs a joint Cause of the Circulation of the Blood, and perhaps the primary Cause of other Circulations: as indeed it is with Respect to the Blood from the Commencement of the Act of Breathing, since it is evident, that if the Lungs stand still the Blood will no longer circulate. To be farther convinced of the Use of *Respiration* in the Affair of *Circulation*, the curious Reader may consider the Experiments, which were made to this Effect by the Doctors *Hurston*, *Croon*, and *Musgrave*, as they are related by Dr. *Derham* in his *Physico-Theology*, among the Notes upon the Chapter of *Respiration*.

This is the *Oeconomy* of Nature after an human Creature hath once received into *it's Nostrils* the *Breath* of animal Life. In the *Womb*, as the *Passage* of the *Blood* is different, so is the *Cause* of *Circulation*; whilst the *Fœtus* is as one Body with the Mother, and there is no Occasion, nor Place for *Respiration*; there are *two Passages* on Purpose for the *Transmission* of the Blood without passing it thro' the *Lungs*. The Blood, says *Chiselden*, which is brought to the Heart by the ascending *Cava*, passes out of the right *Auricle* into the left, through
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a Passage called *Foramen ovale*, in the *Septum* (common to them both) without passing through the *right Ventricle* as after the Birth, while the Blood from the descending *Cava* passeth through the *right Auricle* and *Ventricle* into the *pulmonary Artery*, and thence into *Aorta*, through the Duct betwixt that and the *Pulmonary Artery*, called *Ductus Arteriosus*, whilst a small Portion of the Blood thrown into the *pulmonary Artery* passes through the Lungs, no more than is sufficient to open the *Pulmonary Vessels*. Thus both *Ventricles* are employed in driving the Blood through the *Aorta* to all Parts of the *Fœtus*, and the Mother too. Which leads me to speak of what I hinted at in the Beginning of the Book, the *Cause of Circulation* in the *Fœtus* wherein, I chuse likewise to follow *Dr. Drake*, whom the Reader may consult at large tho' his Opinion may be understood from the following Quotation :

“ The only Animal that is exempted from this necessary condition of Breathing, or receiving and expelling alternately some fluid into and out of the Body, is a *Fœtus*. But this, while included in the Womb, has little more than a vegetative Life, and ought scarce to be reckoned among the number of Animals. For, were it not for that small share of Muscular Motion, which it exercises in the Womb, it might without absurdity be accounted for as a Graft upon, or Branch of the Mother.

Concerning the immediate Matter, and means of Life, and Nutrition, Authors are not agreed; nor is it the business of this place to reconcile, or decide their Differences, but to account for the Motion of the Blood through the Vessels only. In order to this, it will be necessary to observe, that the Pulsation of the Heart in a *Fœtus* is so very weak and obscure, and the Motion of the Blood so extremely slow and languid, as to be scarce, if at all, perceivable, as has been experienced in the Dissection of Puppies before Respiration had. To produce such a feeble Palpitation, and creeping Motion, no greater force seems to be required than may be derived from the Communication between the Vessels of the Mother and *Fœtus* in the *Placenta*. I am not ignorant, that divers very Learned Anatomists (whom the Crowd have implicitly followed) have absolutely rejected all Communication between these Vessels. But, with Submission to great Authorities, I think they have acted arbitrarily, and without sufficient Warrant from Reason or Experiment. For neither are the Arguments, which they bring against it conclusive, nor the Office which they assign to the Umbilical Vessels in lieu of it, proper or natural to those Vessels, or the reality of the Fact made out by any substantial Reasons. Those that reject this Communication usually do it in favour of one or both of these Opinions, that the Arteries of the *Uterus* do deposite a
Nutritive

Nutritive Juice, or a Juice impregnate with Air in the *Placenta*, which is suck'd in by the Umbilical Vein, and convey'd to the *Fœtus*, for the necessary Uses of Nutrition and Life. Now those that patronize either of these Opinions lead Nature an unnecessary Dance. For if the Maternal Blood does really contain any such Nutritions, or any such necessary Aerial Particles, why should they be separated and extravasated, to be with difficulty received into the Umbilical Vein, and again mixt with the Blood; when they might more easily have been imparted by the plain simple way of Transfusion from the Arteries of the Mother to the Veins of the *Fœtus*?

This seems to be the *Oeconomy* of Nature for preserving the Motion of the Blood in the *Fœtus*; but the Circulation of the Blood is not only thus various in the different Stages of Being; it even admits of great Variety at the same Period, in the same Creature. The Circulation of the Fluids in the very *small Vessels* of Animals is a species of Motion, that requires a distinct Consideration. Dr. WHYTT, who has written with great Learning and Sagacity upon this Subject observes very justly in the beginning of his Treatise, that tho' the Circulation of the Blood has been almost universally acknowledged, for above a Century past, and much has been written to explain this Doctrine; yet there are several Things relating to it, which have not been hitherto accounted

counted for in so satisfactory a Manner, as to render any farther Inquiry into them altogether superfluous. He proceeds then, beside the Force of the Heart, to consider the *Contraction* of the *Arteries*, *Gravity*, and the *Attraction* of *capillary Tubes*, as Causes of the Circulation, in the small Vessels of Animals.

With Respect to the *Blood* in particular, he acknowledges the *Contraction* of the Heart to be the *principal* Cause which propels it through the Body; but as the Current, thus occasioned, is continually meeting with Obstructions, which diminish its Force, he proceeds to calculate the Diminution: I shall give the Reader, upon this Head, an Abstract of his Doctrine.

“ If the Force, says he, with which the
“ Blood is thrown by the left Ventricle of the
“ Heart into the Aorta, be supposed equal to
“ the Pressure of a Column of Blood 90 Inches
“ high, the Momentum of this Fluid in any
“ Artery will be found by multiplying the
“ *Area* of the transverse Section of any Artery
“ into 90, the Height of that Column of
“ Blood, whose Pressure is supposed equal to
“ the protrusive Force of the Heart. Upon
“ this Principle, and the Help of other Calculations, concerning the Diameter of a circulating red Globule of Blood, the Diameter of a red capillary Artery, and the Excess of the Sum of the Areas of all the capillary Arteries above that of the Aorta, he
“ makes it out, that since a Globule of red
“ Blood

“ Blood, weighs nearly $\frac{1}{1000}$ Part of a
 “ Grain, it follows that the *Moment*, or press-
 “ ing Force, of such a Globule in its *capillary*
 “ Artery, arising from the *Impulse* of the
 “ HEART does not exceed twice it's own
 “ Weight. But even this *Moment*, however
 “ small it may appear must be diminished
 “ by Friction to such a Degree, that he
 “ gathers, from a reasonable Calculation, the
 “ Moment of a single *Globule* in such a *Ca-*
 “ *pillary* Artery to be to the Moment of the
 “ same in the *Aorta*, as 1. to 1398.”

“ FURTHER, the Loss of Motion from
 “ Friction depends not only upon the Smalness
 “ of the Vessels, but also upon their *Distance*
 “ from the Heart. AGAIN, the Velocity of
 “ the Blood will be different according to the
 “ different *Angles*; at which the Branches go
 “ off from their Trunks; and moreover the
 “ various Flexures and Convolutions of the
 “ small arterial Ramifications must increase
 “ the Friction in them, and consequently
 “ still farther retard the motion. From what
 “ has been said, it may appear that the Ve-
 “ locity of the Blood will not be the same in
 “ all the Arteries of the same *Diameter*, but
 “ will be greater or less according to their Di-
 “ stance from the Heart, the Excess of the
 “ Areas above their Trunks, the Angles at
 “ which they go off, and the Number and
 “ Degree of their Flexures.”

Having said this, and a great Deal more
 to

to shew that the Force of the Heart itself is not sufficient to carry on the Circulation, he next considers the alternate *Contraction* of the *Aorta* and it's Branches, as justly reckoned among the Causes of the Motion of the Blood ; then in the same View he speaks of *Gravity*, and the Attraction of capillary Tubes, in the Room of which Dr. DRAKE has substituted, as a more adequate Cause, the Action of the Lungs. For he makes it not only the *primary* Cause of the Motion of the Heart, but also as an *Auxiliary* to it in acting against the anterior Mass of Blood and forwarding it thro' the smaller Vessels, by admitting the various Pressures of the Air, and so continually altering the Dimensions of the Vessels.

In this Diversity of Opinions the judicious Reader has a right to adopt that, which shall appear to him the most reasonable. To speak my own sentiments, I look upon the *human* Body, as an *Hydraulick* Machine, wherein, as in others of that Sort, the Fluids ascend by *Force* and *Protusion* : in their Descent, *Gravitation*, especially in such a large *Cascade* as the *descending Cava*, may have its Place : tho' as it promotes it one Way, it may retard it another : also in the *capillary* Vessels, and in those which are arched, or crooked, or in an *horizontal* Direction, with respect to the Motion of the *Fluids*, Gravitation seems to be rather an Impediment, than of Use. *Attraction* likewise can only act an *under Part* to FORCE or IM-

PULSE being without the Addition of Force, indeterminate in its Directions, and as likely to oppose any Intention, as promote it. For granting, that *Capillary Tubes* will attract a Fluid, yet without FORCE to give Direction, they are as much disposed to attract one Way, as the other. And for *Irritation*, as the Arteries are said to be *without feeling*, and the inner Coat not proved to be *nervous*, it scarce can be relied on as a Cause. For this Reason, if a *Pulse* * remain in any Vessel after the *Pulse* of the Heart is stopped, one would imagine that it should be rather attributed to the *Continuation* of the Motion the Fluid, originally agitated by the Motion of the Heart, than to any *Stimulus* or Irritation in the Liquor teasing the side of the Vessel, or Artery. For *Undulation* may be continued onwards, till the Force first impressed be spent; tho' the Impulse may not be repeated from behind. If the *Impetus* be repeated, there will ensue a fresh *Pulse*, and the *Fluid* undergo a fresh *Protusion*, which *Protusion* will dilate the Coats of the Vessels, as their *Elasticity* will contract them. Upon the same Principle of Elasticity likewise we may account for some of the Operations of another sort of *Pipe*, and explain, in great Measure, the Cause of the *peristaltick Motion*. It may be the Fashion of the Times, but it is not quite consistent with true Philosophy to attri-

* Dr. *Whytt's Physiological Essays*, p. 40.

bute so much to *Irritation* : unless by this metaphorical Expression, they understand not only *Uneasiness* ; but an *Uneasiness*, which proceeds from Weight and Pressure, which produces *Elasticity* ; and then *Elasticity*, and *Irritation* will do the same Office, if they be not the same Thing in Nature. For suppose a Portion of an *Intestine* marked A B C ; upon the Principle of *Elasticity*, the Fibres of the Gut at A shall be contracted after being delivered of the Load now advanced to B ; their Contraction still continuing, urges the Load B still stronger against C ; when the Fibres at C, being more oppressed, expand themselves in their Turn, and being some of them of an *annular* or *spiral* nature, again protude the Load by their Contraction : Is not this the Work of *Elasticity* as well as *Irritation* ? The same Cause prevails in other *Vascular* Dilatations and Contractions : suppose them to be in *Arteries* or *Veins*. Here a strong Injection of the Fluid dilates and swells the Coat of the Vessel, which being delivered of the Burden, as it passes on, recovers itself again by Contraction.

ELASTICITY therefore seems to be a more general and a surer Principle than Irritation ; inasmuch as it certainly exists in Vessels of such a fibrous Texture, as those of an human Body, and affords a *Reaction*, upon the Application of any Force, by which we may rationally explain many Appearances in *animal*
Oeconomy,

Oeconomy, which otherwise might pass for great Difficulties.

I could willingly have dwelt longer upon this useful and noble Subject of PHYSIOLOGY, which at the same Time, that it is subservient to the Preservation of *Mankind*, affords us such a surprising Demonstration of the infinite WISDOM and POWER of GOD. I hope however, that I shall have given some Satisfaction to Persons, who were hitherto Strangers to Speculations of this Sort, tho' I am at present obliged to desist.

—Priusquam vero manum de tabula, paucis te volo, *Erudite* LECTOR. Opus, ut vides *absolvi*, si quicquid finitum est, dici potest *absolutum* : quod prætermisi, quod percurri negligentius, non tam nostræ inertiae tribuendum est, quam temporibus hisce nostris, et pulchris istis *Temporum Rectoribus* ; qui publica stipendia pro pignore habentes suis *Nebulonibus* turpiter largiundo, *Virtutis et Ingenii Præmia* disperdunt *insolenter*. Si DEUS *Optimus Maximus* conjurationem illam nefariam penitus dissiparet ; si rueret, raperet, ageret, tunderet, prosterneret, quot commoditates inde perciperet respublica ? et quantum artium liberalium Incrementum ? Hæ enim, ut ait CICERO, *aluntur Honoribus, jacentque semper*, si indignissimi Homines, et in omni re literaria rudes, vel principis negligentia, vel *populi culpa*, summo imperio potiuntur.

F I N I S.

E R R A T A.

- Pag. 144. for *shall is*, read *shall be*
 200. for *Learned gives*, read *Learned give*.

THE STATE OF NEW YORK
IN SENATE
January 10, 1882.
REPORT
OF THE
COMMISSIONERS OF THE LAND OFFICE
IN ANSWER TO A RESOLUTION
PASSED BY THE SENATE
MAY 10, 1881.
ALBANY:
J. B. LEECH, STATE PRINTER.
1882.

ALBANY, N. Y.,
JANUARY 10, 1882.
SIR:
I have the honor to acknowledge the receipt of your letter of the 27th inst., and in reply to inform you that the same has been forwarded to the proper authorities for their consideration. I am, Sir, very respectfully,
Yours, very truly,
J. B. LEECH,
COMMISSIONER OF THE LAND OFFICE.

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